

20-1025 (Lead); 20-1138 (Consolidated)

**UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT**

ENVIRONMENTAL HEALTH TRUST; CONSUMERS FOR SAFE CELL
PHONES; ELIZABETH BARRIS; THEODORA SCARATO

CHILDREN'S HEALTH DEFENSE; MICHELE HERTZ; PETRA BROKKEN;
DR. DAVID O. CARPENTER; DR. PAUL DART; DR. TORIL H. JELTER; DR.
ANN LEE; VIRGINIA FARVER, JENNIFER BARAN; PAUL STANLEY, M.Ed.

Petitioners

v.

FEDERAL COMMUNICATIONS COMMISSION;
UNITED STATES OF AMERICA

Respondents

Petition for Review of Order Issued by the
Federal Communications Commission

DEFERRED JOINT APPENDIX**VOLUME 19 (CORRECTED)**

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Dr. Joel Moskowitz, PhD. Reply Comments, Why the FCC
Must Strengthen Radiofrequency Radiation Limits in the U.S.,
Nov. 5, 2013

Why the FCC Must Strengthen Radiofrequency Radiation Limits in the U.S.

Joel M. Moskowitz, Ph.D., Director
Center for Family and Community Health
The UC Berkeley Prevention Research Center
School of Public Health
University of California, Berkeley

November 5, 2013

Since 2009, when my colleagues and I published a review of the research on mobile phone use and tumor risk in the ***Journal of Clinical Oncology***¹, I have advocated for stronger radiofrequency radiation limits that adequately protect children and adults from **non-thermal** as well as thermal health risks. Wireless devices must be tested in a manner that resembles how consumers actually use them, and the wireless industry should be required to provide to consumers meaningful disclosure of health risks and ways to reduce harm without pre-empting the rights of localities to require additional disclosures.

Following is a compilation of press releases I have prepared since April, 2012, along with selected news articles related to these releases. These materials summarize the latest health research on wireless radiation and related public health policy developments.

¹ Myung SK, Ju W, McDonnell DD, Lee YJ, Kazinets G, Cheng CT, Moskowitz JM. Mobile phone use and risk of tumors: a meta-analysis. ***Journal of Clinical Oncology***. 27(33):5565-5572. 2009.

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Cellphones and Health by Dr. Joel Moskowitz

Reprinted from *The Green Gazette* (British Columbia), Issue #22, Sept/Oct 2013, pp. 8-9

In the last issue we explored the potential hazards of electromagnetic radiation from iPad use. We learned about warnings from the European parliaments and doctors' associations in various countries, and discussed the differences between pulsed digital wireless signals and continuous analogue radio waves. This time we are pleased to invite Dr. Joel Moskowitz to share his research findings regarding the health effects of cellphones.

I started studying the effects of cellphone radiation when Dr. Seung-Kwon Myung, a physician and epidemiologist from the National Cancer Center of South Korea, spent a year working in my center at UC Berkeley. He specializes in meta-analysis, a method by which data are combined across studies to generate more robust conclusions.

My colleagues and I reviewed research that examined the association between cellphone use and tumor risk. When we grouped the 23 studies based upon quality of the research, we found strong group differences. In the 13 studies which failed to meet scientific best practices, we found what appeared to be reduced tumor risk. The 10 higher-quality studies found a harmful association between cellphone use and tumor risk. Also, the higher quality studies had no funding from the cellular industry whereas the lower quality studies had at least partial industry funding.

Since our study was published in the *Journal of Clinical Oncology* in 2009, I have reviewed hundreds of cellphone radiation studies. There is evidence that cellphone radiation may damage sperm and increase male infertility, increase risk of reproductive health problems, increase brain glucose metabolism, and alter EEG readings.

Many individuals have reported developing a sensitivity to cellphone radiation and other forms of radiofrequency energy. They experience various allergic symptoms which may include ringing in their ears, headaches, dizziness, an irregular heartbeat, and memory and sleep problems. This condition, known as electromagnetic hypersensitivity, is considered a functional impairment in Sweden. The incidence of this condition, which is not easily diagnosed, appears to be increasing in many countries with the proliferation of “electrosmog.”

We need more research on the short-term and long term risks; risks to children and adolescents who are more vulnerable; reproductive health risks, and risks of newer technologies. We need to better understand the mechanisms that contribute to health effects and how to reduce the risks. Many scientists believe that there are mechanisms other than “heat” at work. Currently, the regulations adopted by most governments, including Canada and the U.S., only address the heating effect produced by cellphone radiation. They completely ignore biologic reactivity.

Cellphone and Brain Tumour Risk

It's premature to estimate long-term tumor risk because tumors can take several decades to develop. A few studies suggest that the risk of glioma, a serious and often deadly brain tumor, doubles after 10 years of cellphone use. This could amount to an additional 10,000 cases per year in the U.S.

Many people have come to rely on their cellphones over land lines, and many children start using cellphones at a young age, so we may see increased risk in the future. On the other hand, changes in the pattern of use (e.g. hands-free, texting) can reduce health risks. Also, technology is changing; yet we don't know if newer technologies are safer or more harmful. It is difficult for scientific research about long-term effects to keep up with the speed at which companies bring forth new consumer radiofrequency microwave devices. This behooves us to practice precaution.

Cellphone Radiation Damages Sperm

On June 28, 2012 the Environmental Working Group (EWG) reported: "EWG scientists have analyzed 10 scientific studies documenting evidence that cellphone radiation exposure leads to slower, fewer and shorter-lived sperm. The research raises concerns for men who carry their phones on their belts or in pants pockets. This conclusion is supported by a review paper recently published in the *Journal of Andrology*:

"The results showed that human spermatozoa exposed to RF-EMR (radio frequency electromagnetic radiation) have decreased motility, morphometric abnormalities, and increased oxidative stress, whereas men using mobile phones have decreased sperm concentration, decreased motility (particularly rapid progressive motility), normal morphology, and decreased viability. These abnormalities seem to be directly related to the duration of mobile phone use." (La Vignera et al, 2012).

Infertility has become a mounting problem in America and Canada. According to Statistics Canada, infertility in Canada has almost doubled between 1992 and 2010, not just among couples who got married older, but also among younger couples in their 20's.

Cellphone Radiation, Pregnancy and Children

The latest, peer-reviewed science finds prenatal cellphone radiation exposure damages test mammals' offspring. Several new, independent studies confirm previous research that pulsed digital signals from cellphones disrupt DNA, impair brain function, and damage sperm.

Many studies have found that exposure to low-intensity cellphone radiation can open the blood-brain barrier. This can enable toxins in the blood to penetrate the brain. A recent study found that children who used cellphones were more likely to exhibit ADHD (attention-deficit hyperactivity) symptoms than children who did not use them, but this effect was observed only among children who used cellphones who had slightly elevated lead levels in their blood. Moreover, in the children with some lead in their blood, the more they used their cellphones, the more likely they had ADHD symptoms.

On December 12, 2012, the American Academy of Pediatrics sent a letter to the U.S. Federal Communications Commission (FCC) requesting reassessment of cellphone exposure limits:

“Children are disproportionately affected...The differences in bone density and the amount of fluid in a child’s brain compared to an adult’s brain could allow children to absorb greater quantities of RF (radiofrequency) energy deeper into their brains than adults. It is essential that any new standards for cellphones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded through their lifetimes.”

The U.S. Government Accountability Office (GAO) issued a report last summer calling on the FCC to update cellphone exposure limits and testing requirements. The report noted that the testing requirements are inadequate as cellphones are being used closer to the head and body than the test requires. Thus, actual users' exposure to cellphone radiation may exceed the legal limit.

Are all Cellphones Equal with regards to Radiation?

The amount of cellphone radiation your phone emits depends on various factors, including your location and distance from cell towers. Some cellphones generate as much as eight times more radiation than others. A measurement, called the SAR (Specific Absorption Rate), is available on the internet for every cellphone, but this measures the maximum amount of radiation emitted, not the typical amount. You can't find out how much radiation a phone generates during average daily use, which may be more important in terms of cumulative health risk. Some low SAR phones may generate more radiation on average than high SAR phones.

Your cellphone carrier also matters. One study shows that GSM phones can emit 28 times more radiation on average than CDMA phones. Another study shows GSM affects EEG readings more than CDMA. Your cellphone carrier determines which type of phone you have. In the U.S., people can choose to use a CDMA phone by selecting Verizon or Sprint; however, in Canada all carriers use GSM phones. Soon voice calls will use 4G technology, that is LTE, instead of GSM or CDMA. More comparative studies on different carrier standards are needed, especially the newer standards.

Recommendations on Cellphone Usage

Although further research is needed, we cannot afford to wait for conclusive evidence. There are more than 300 million cellphones in use in the U.S. Two-thirds of children eight and older use them. The government's regulations are outmoded and need to be revised. About a dozen nations have issued precautionary health warnings. It is time to publicize practical ways in which people can minimize their personal health risk. In addition, I have recommended an annual assessment of \$1 on each cellphone. In the U.S., this would generate \$300 million annually for vitally needed research and education.

Here are some practical steps which cellphone users can easily adopt:

- Keep your cellphone away from your body. Don't keep the phone near your head or reproductive organs whenever it is turned on. Don't sleep with the phone near your bed. The amount of radiation is related to the square of the distance, so keeping your phone 10 inches away reduces your exposure 100-fold compared to an inch.
- Use a corded headset or other hands-free method such as a speakerphone or text. Keep your calls short.
- Minimize cellphone use among children, teens, and pregnant women. A child's brain absorbs twice as much radiation as an adult brain.
- Don't use your phone when the signal is weak, for example, on an elevator or in a moving vehicle, as the phone is designed to increase its signal strength to compensate.
- When carrying a cellphone in your pocket: Keep the cellphone turned off, or deactivate its signals (i.e. keep it on airplane mode, plus turn off the WiFi and Bluetooth functions). Turn it on or activate it periodically to check for messages, or check for messages from a land line. The cellphone is designed to send signals to cell towers regularly to identify its location, whenever it's turned on. The WiFi antenna in a smartphone sends beacon signals continually if it's not turned off.
- Demand that the government revise regulations, fund research, and issue precautionary health recommendations.

Dr. Joel Moskowitz is on the research faculty at the University of California, Berkeley, School of Public Health. He has conducted research on chronic disease prevention and health promotion for more than 30 years, has authored dozens of peer-reviewed health publications, and is Director of UC Berkeley's Center for Family and Community Health

Article References: <https://docs.google.com/file/d/0BxkLXVmAlolilaGVsVUZTbVUZdG8/edit>

For more information, contact: Joel M. Moskowitz, Ph.D., email: jmm@berkeley.edu; Electromagnetic Radiation Safety Website: <http://www.saferemr.com/> or on Facebook at <https://www.facebook.com/SaferEMR>.

For the online version of this magazine article published in the Sept./Oct. issue of ***TheGreenGazette*** including graphics: <http://bit.ly/18RXE7x>

Dr. Joel Moskowitz: Cellphone Radiation and Health**References and Further Reading**

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Environmental Working Group review of sperm damage research

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Dr. Dariusz Leszczynski's science blog on mobile phone radiation and health:

<http://betweenrockandhardplace.wordpress.com/>

Video (1 hour, 58 minutes):

<http://www.youtube.com/watch?v=tnn6gNyRU7g>

Infertility rates rising for Canadian couples <http://o.canada.com/2012/02/15/infertility-rates-rising-for-canadian-couples/>

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La Vignera et al. Effects of the exposure to mobile phones on male reproduction: a review of the literature. Journal of Andrology. 2012 May/June: 33(3):350-356.

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CNET Report: Cellphone use could reduce sperm count

Dong Ngo, August 18, 2011

http://www.cnet.com/8301-17918_1-20093675-85/report-cell-phone-use-could-reduce-sperm-count/

Does The FCC Plan To Rubber Stamp Outdated Cell Phone Radiation Standards?

More research on cell phone radiation is needed before we replace our outdated guidelines. In the interim the US should disseminate precautionary health warnings. A \$1 annual fee per cell phone would generate \$300 million for research and education.

Joel M. Moskowitz, PRLog (Press Release), Jun 15, 2012

The Federal Communications Commission (FCC) will conduct a formal review of the U.S. cell phone radiation standards according to a Bloomberg news report.

An FCC spokesperson emailed a statement to a Bloomberg reporter that is truly alarming. Her message suggests that the FCC has already decided that the current standards are fine, and will conduct a review to rubber stamp the 1996 FCC guidelines:

"Tammy Sun, a spokeswoman for the agency, said in an e-mailed statement. The notice won't propose rules, Sun said.

'Our action today is a routine review of our standards,' Sun said. 'We are confident that, as set, the emissions guidelines for devices pose no risks to consumers.'"

(Todd Shields, Bloomberg, Jun 15, 2012; "Mobile-Phone Radiation Safety to Be Reviewed by U.S. FCC"; <http://www.bloomberg.com/news/2012-06-15/mobile-phone-rad...>)

The Bloomberg article cites a major review of the literature conducted by our research center in which we found an association between mobile phone use and increased brain tumor risk especially after 10 years of cell phone use:

"There is possible evidence linking mobile-phone use to an increased risk of tumors, according to a study of scientific studies and articles that was published in 2009 in the Journal of Clinical Oncology." (<http://jco.ascopubs.org/content/27/33/5565.abstract>)

The research we reviewed and subsequent research strongly suggest that the current standards for cell phone radiation are not adequate to protect us from health risks associated with exposure to cell phone radiation. A year ago, a 31-member group of experts convened by the World Health Organization agreed with our conclusions and classified cell phone radiation a "possible carcinogen."

The FCC standards were established in 1996 at a time when few adults used cell phones. Today, children and most adults are exposed to far more cell phone radiation than the FCC-approved test models are subjected to when new cell phones are certified. Moreover, the test assumes that cell phones can harm us only by heating tissue. This is not true as there are numerous studies that demonstrate non-thermal effects from cell phone radiation including increased glucose metabolism in the brain, generation of heat shock proteins, free radicals, and double-strand DNA breaks; penetration of the blood-brain barrier, damage to sperm and increased male infertility.

The FCC admits on its web site* that

"there is no federally developed national standard for safe levels of exposure to radiofrequency (RF) energy."

"The FCC's guidelines and rules regarding RF exposure are based upon standards developed by IEEE and NCRP and input from other federal agencies." (<http://www.fcc.gov/guides/wireless-devices-and-health-con...>)

I have grave concerns if the FCC continues to rely on industry-funded expert groups because our research found that industry-funded epidemiologic research was generally of lower quality and biased against finding harmful effects. Dr. Henry Lai at the University of Washington has come to a similar conclusion in his analysis of the toxicology research.

In my opinion, it is premature to adopt new safety standards because we need more research that is independent of the wireless industry's influence. The Federal government needs to sponsor a major research initiative on the health effects of electromagnetic radiation. Martin Blank and Reba Goodman from Columbia University recently published a paper in the journal, *Electromagnetic Biology and Medicine*, calling for the development of a biologically-based measure of electromagnetic radiation (Blank and Goodman, Electromagnetic fields and health: DNA-based dosimetry. *Electromagnetic Biology and Medicine*. Posted online on June 7, 2012; <http://informahealthcare.com/doi/abs/10.3109/15368378.2011.624662>).

In the interim, to protect cell phone users we must adopt and disseminate precautionary health warnings that promote safer cell phone use. Although the FCC web site provides some simple steps to reduce exposure to cell phone radiation, it "does not endorse the need for these practices." A dozen nations and the city of San Francisco have issued precautionary warnings about cell phone use to its citizens. It is time for our Federal government to do so.

<http://prlog.org/11901340>

Better Late Than Never? FCC to Review Cell Phone Radiation Standards

After procrastinating for almost ten years, the FCC seems prepared to review its outmoded wireless radiation standards. But will industry force the FCC to maintain the status quo or even weaken the inadequate standards?

Joel M. Moskowitz, PRLog (Press Release), Feb. 5, 2013

The FCC will close the public comment period on proposed changes in rules and procedures regarding human exposure to radiofrequency electromagnetic energy tomorrow, February 6. (1) The outmoded rules and procedures that regulate cell phones and other wireless devices were originally adopted in 1996 when there were only 38 million cell phone subscriptions in the U.S. (2)

The FCC's public comment period was opened almost ten years ago on July 14, 2003. (1) At that time there were 148 million cell phone subscriptions in the U.S. (2)

Now there are 322 million cell phone subscriptions. (2) Today, many children, teenagers, and women use cell phones that are tested using a model of a large male adult's brain and body. Meanwhile research has shown that a child's brain absorbs 2-3 times more electromagnetic radiation (EMR) than an adult's brain.

Why has the FCC procrastinated in revising these rules and procedures? The standards were developed prior to 1996 by industry groups to protect workers and the general population only from the thermal or heating effects of exposure to EMR.

The standards ignore the health risks posed by nonthermal effects of EMR which have been reported in hundreds of peer-reviewed laboratory studies. Also, we now have evidence from human studies of increased risk of cancers of the brain and salivary gland from long term use of cell phones that comply with these outdated standards. The World Health Organization has classified radiofrequency EMR as "possibly carcinogenic" to humans, based on the results of large case-control studies of cell phone use among adults.

We also have evidence of sperm damage from cell phone radiation and increased male infertility among cell phone users and preliminary evidence of reproductive health effects.

Although more research is needed to assess the long term risks to children who use cell phones, Wi-Fi and other wireless devices, the research to date suggests that these risks will exceed those found among adult users. We must not continue to experiment with our children by exposing them to increasing amounts of EMR through wireless technologies. Installing Wi-Fi in schools and on buses and airplanes is likely to increase health risks over the life span.

Last summer the Government Accountability Office issued a report calling on the FCC to review cell phone standards and testing procedures. Although this report made numerous mistakes which have been documented by myself (3) and other experts, it appears to have succeeded in prompting the FCC to close the public comment period and initiate a review.

It is critically important that the public and those with expertise weigh in on the review process because the FCC pre-empted the GAO Report last summer and announced to the media that they either do not plan to change the standards or may even weaken them. (4) The industry has been lobbying the FCC for many years to adopt international standards which are far weaker than the standards adopted by the U.S. and a handful of other nations.

In the comments I filed on the FCC website today, I entered into the public record the contents of my Electromagnetic Radiation Safety web site, <http://saferemr.com>, which contains commentary, news releases, and media coverage. (5) I also attached my comments on the problems with the GAO Report that were prepared at the request of staff members for Representatives Waxman, Markey, and Eshoo, the three members of Congress who requested this report from the GAO. (3)

The recommendations I made are as follows:

- "In my professional opinion, the FCC should request the EPA to empanel a Working Group composed of health experts who have no conflicts of interest with industry to review the scientific literature on EMR. The Group should recommend biologically-based EMR standards that ensure adequate protection for the general public and occupational health based upon the precautionary principle. Finally, the FCC should adopt the standards, testing procedures, and appropriate precautionary warning language recommended by the Working Group." (5)
- "The FCC should not take any actions that may increase exposure of the population to EMR from cell phones, base stations, Wi-Fi, Smart Meters and other RF- or ELF-emitting devices. The FCC must especially protect vulnerable groups in the population including children and teenagers, pregnant women, men of reproductive age, individuals with compromised immune systems, seniors, and workers." (5)

For more information on the health effects of electromagnetic radiation exposure from cell phones, Wi-Fi, and Smart Meters, and discussion of health policies to reduce potential harm, see my Electromagnetic Radiation Safety website at <http://saferemr.com>.

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- (4) Joel M. Moskowitz. "Does The FCC Plan To Rubber Stamp Outdated Cell Phone Radiation Standards?" PRLog. June 5, 2012. URL: <http://www.prlog.org/11901340>
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<http://www.prlog.org/12073996-better-late-than-never-fcc-to-review-cell-phone-radiation-standards.html>

**Did Tom Wheeler, Nominee for FCC Chair,
Subvert Research Showing Harm From Cell Phone Radiation?**

A wireless industry publication alleged that Mr. Wheeler suppressed and biased the research from the nation's largest mobile phone health research project.

Joel M. Moskowitz, PRLog (Press Release), May 28, 2013

Tom Wheeler, head of the CTIA from 1992-2004, has been nominated to become the next Chairman of the Federal Communications Commission (FCC).

RCR Wireless News, an industry publication, alleged that Mr. Wheeler suppressed and biased the research from the nation's largest mobile phone health research project while he served as head of the CTIA, the wireless telecommunications industry association.

Wireless Technology Research L.L.C. was a 6-year, \$28 million research program funded by mobile phone carriers and manufacturers from 1993 to 1999.

The strategies allegedly used by the CTIA were similar to those employed by the Tobacco Industry for many decades to downplay the dangers of cigarette smoking. After six years of litigation by the Department of Justice, a Federal court finally found the Tobacco Industry guilty of fraud and racketeering in 2006.

How long will it take before the curtain is pulled back on the Wireless Industry's longstanding strategy to co-opt the scientific community, and suppress and bias the research on the health effects of cell phone and wireless radiation?

RCR Wireless News has been reporting about the wireless and mobile phone industry for industry executives since 1981. It is the official show daily for some of the industry's biggest trade shows including the CTIA. (4)

For a summary of the allegations against Mr. Wheeler according to *RCR Wireless News*, see <http://saferemr.blogspot.com/2013/05/did-tom-wheeler-nominee-for-chairman-of.html>.

<http://www.prlog.org/12146045>

What's Wrong with the GAO Report on Cell Phone Radiation?

The US General Accountability Office issued a report calling for reassessment of mobile phone exposure and testing requirements. The report had many flaws although it made one good recommendation -- the FCC needs to re-assess testing requirements.

Joel M. Moskowitz, PRLog (Press Release), Jan 10, 2013

Comments on the 2012 GAO Report: ***“Exposure and Testing Requirements for Mobile Phones Should Be Reassessed”***

Joel M. Moskowitz, Ph.D.
Director, Center for Family and Community Health
School of Public Health
University of California, Berkeley

August 24, 2012

Introduction

U.S. General Accountability Office (GAO). ***Exposure and Testing Requirements for Mobile Phones Should Be Reassessed***. GAO-12-771. Washington, DC: General Accountability Office.
<http://www.gao.gov/products/GAO-12-771> .

The GAO Report selectively reviewed scientific literature that supports the FCC's claim that cell phones which comply with the federal standards are safe. The GAO did not consider the methodologic limitations of this research or the alternative interpretations of the results from these studies. The GAO Report did not review the scientific evidence that strongly suggests the FCC standards which control only for thermal effects do not adequately protect the public from harm due to non-thermal effects from long-term exposure to cell phone radiation.

Although we do not have conclusive proof that cell phone radiation is harmful to humans, the FCC certainly cannot prove its claim that cell phones that comply with current federal standards are safe. The claim relies on many assumptions about the science. A critical review of the science—as opposed to simply “weighting the evidence”—reveals that these assumptions have dubious validity, and that there is sufficient evidence to require the development of stronger, biologically-based standards that protect against sub-thermal exposures.

A link to my 11 page commentary on the GAO report is available on my blog site at
<http://saferemr.blogspot.com/2013/01/commentary-gao-2012-report-on-mobile.html>.

<http://www.prlog.org/12057270-whats-wrong-with-the-gao-report-on-cell-phone-radiation.html>

WHO Monograph on Cancer Risk from Mobile Phone Use Released

The World Health Organization concludes there is “limited evidence” in both humans and laboratory animals for the carcinogenicity of radiofrequency radiation, especially from cell phones.

Joel M. Moskowitz, PRLog (Press Release), Apr 19, 2013

The International Agency for Research on Cancer (IARC) of the World Health Organization (WHO) published its long-awaited monograph on the cancer risk to humans from exposure to cell phone radiation and other radiofrequency electromagnetic fields. The primary focus of the review is on the microwave radiation emitted by cell phones.

According to the monograph, “Radiofrequency electromagnetic fields are possibly carcinogenic to humans (Group 2B).” (p. 421) Children are particularly vulnerable to this carcinogenic effect as “the average exposure from use of the same mobile phone is higher by a factor of 2 in a child’s brain and higher by a factor of 10 in the bone marrow of the skull.” Also, the child’s brain is developing at a greater rate than the adult brain.

The human research reviewed by IARC examined people who used legally-acquired cell phones that passed regulatory standards. They were exposed to nonthermal doses of microwave radiation from their cell phones. Yet IARC concluded there is evidence, though somewhat limited still, that these exposures caused increased risk of glioma and acoustic neuroma. Thus, it is time for all nations to review their cell phone regulatory standards and testing procedures in order to protect their citizens from preventable risks. Also, it is critical that governments provide ample warnings to cell phone users how to use their phones safely.

This 471 page report is based on the consensus of a Working Group of 31 international experts who met in Lyon, France in May, 2011. Although a few studies published since this meeting were included in this monograph, other recent studies that further support the evidence for increased cancer risk due to exposure to cell phone radiation were not reviewed.

The monograph only examines research on cancer risk. Other research has found that cell phone radiation has additional harmful effects on humans, especially on sperm and the fetus.

To see what I consider the most important quotes from the monograph, go to my Electromagnetic Radiation Safety web site: <http://saferer.com> . A link to the full monograph is available there.

<http://www.prlog.org/12122198-who-monograph-on-cancer-risk-from-mobile-phone-use-released.html>

Most Significant Government Health Report on Mobile Phone Radiation Ever Published

Today, the World Health Organization's (WHO) new monograph on cancer risk from mobile phones and other sources of RF radiation is featured on the home page of the WHO's International Agency for Research on Cancer (IARC).

Joel M. Moskowitz, PRLog (Press Release), Apr 24, 2013

The new W.H.O. monograph explains why the W.H.O. classified mobile phone and other sources of radiofrequency radiation as "possibly carcinogenic" for humans. (1) These forms of electromagnetic radiation have been categorized as a Group 2B carcinogen along with lead, automobile exhaust and other toxic substances. (2)

According to the monograph:

- "Positive associations have been observed between exposure to radiofrequency radiation from wireless phones and glioma and acoustic neuroma" (p.421).
- "Radiofrequency electromagnetic fields are possibly carcinogenic to humans (Group 2B)." (p. 421)

Children are particularly vulnerable as "the average exposure from use of the same mobile phone is higher by a factor of 2 in a child's brain and higher by a factor of 10 in the bone marrow of the skull." Also, the child's brain is developing at a much greater rate than the adult's brain.

According to Dr. Joel Moskowitz, this monograph is likely the most significant governmental health report ever published about mobile phone radiation. All governments should study this report and follow the precautionary principle to take appropriate actions including educating the public about safe use, adopting stringent safety regulations, and funding research to develop safer technologies.

For a summary of the contents of this monograph, see the press release I prepared last Friday, <http://www.prlog.org/12122198>, along with supplementary materials, <http://saferemr.com>.

Also, see the coverage by Microwave News: <http://microwavenews.com/short-takes-archive/iarc-publishes-rf-cancer-review>.

The monograph appears today on the WHO/IARC home page (<http://www.iarc.fr>) today and is listed under IARC News: "24/04/2013 Volume 102: Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields."

The 400+ page monograph is available online at:
<http://monographs.iarc.fr/ENG/Monographs/vol102/index.php>

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(2) List of IARC Group 2b carcinogens. Wikipedia. URL: http://en.wikipedia.org/wiki/List_of_IARC_Group_2B_carcinogens

Brain Cancer Risk Increases with the Amount of Wireless Phone Use

New research indicates that brain cancer risk increases with more years of cell phone and cordless phone use and more hours of use.

Joel M. Moskowitz, PRLog (Press Release), Sep 15, 2013

Dr. Lennart Hardell and his colleagues in Sweden just published the third in a series of papers on the use of wireless phones, including cell phones and cordless phones, and the risk of malignant and non-malignant brain tumors. The latest paper describes a new case-control study that examines the association between mobile phone use and brain cancer risk. In these studies, the cases were diagnosed with brain tumors between 2007 and 2009. (1)

The study updates earlier research from case-control studies conducted by the Hardell group and extends the prior research by examining the effects of wireless phone use, i.e., cell phone and cordless phone use, on brain tumor risk for people who have used these phones for up to 25 or more years.

Overall, the research found that people who used wireless phones for more than a year were at 70% greater risk of brain cancer as compared to those who used wireless phones for a year or less. Those who used wireless phones for more than 25 years were at greatest risk—300% greater risk of brain cancer than those who used wireless phones for a year or less.

The total number of hours of wireless phone use was as important as the number of years of use. A fourth of the sample used wireless phones for 2,376 or more hours in their lifetime which corresponds to about 40 minutes a day over ten years. These heavier users had 250% greater risk of brain tumors as compared to those who never used wireless phones or used them for less than 39 hours in their lifetime.

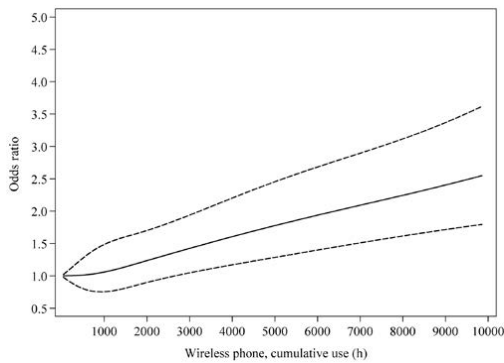
A similar analysis reported in the 13-nation Interphone study funded partly by the World Health Organization found a 182% greater risk of brain cancer among those who used cell phones for 1,640 or more hours in their lifetime.

In the current study, for all types of wireless phone use, brain cancer risk was found to be greater in the part of the brain where the exposure to wireless phone radiation was highest—in the temporal or overlapping lobes of the brain on the side of the head where people predominantly used their phones.

Given consistent results from multiple case-control studies that long-term use of mobile phones (i.e., ten or more years) is associated with brain cancer especially near where the phone is predominantly used, the International Agency for Research on Cancer should strengthen its 2011 assessment of radiofrequency energy from “possibly carcinogenic” to “probably carcinogenic” to humans.

More importantly, governments around the world should heed the results of these studies. The public must be educated about the need to take simple precautions whenever using wireless devices. Governments must strengthen regulatory standards for wireless radiation and must fund research independent of industry to develop safer technologies.

The paper was published online in the peer-reviewed journal, ***International Journal of Oncology***. The abstract and a link to this paper appears below along with the abstracts for the Hardell group's two prior papers from this study. All three papers are open access. (1-3)



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Abstract

Previous studies have shown a consistent association between long-term use of mobile and cordless phones and glioma and acoustic neuroma, but not for meningioma. When used these phones emit radiofrequency electromagnetic fields (RF-EMFs) and the brain is the main target organ for the handheld phone. The International Agency for Research on Cancer (IARC) classified in May, 2011 RF-EMF as a group 2B, i.e. a 'possible' human carcinogen. The aim of this study was to further explore the relationship between especially long-term (>10 years) use of wireless phones and the development of malignant brain tumours.

We conducted a new case-control study of brain tumour cases of both genders aged 18-75 years and diagnosed during 2007-2009. One population-based control matched on gender and age (within 5 years) was used to each case. Here, we report on malignant cases including all available controls. Exposures on e.g. use of mobile phones and cordless phones were assessed by a self-administered questionnaire. Unconditional logistic regression analysis was performed, adjusting for age, gender, year of diagnosis and socio-economic index using the whole control sample.

Of the cases with a malignant brain tumour, 87% (n=593) participated, and 85% (n=1,368) of controls in the whole study answered the questionnaire. The odds ratio (OR) for mobile phone use of the analogue type was 1.8, 95% confidence interval (CI)=1.04-3.3, increasing with >25 years of latency (time since first exposure) to an OR=3.3, 95% CI=1.6-6.9. Digital 2G mobile phone use rendered an OR=1.6, 95% CI=0.996-2.7, increasing with latency >15-20 years to an OR=2.1, 95% CI=1.2-3.6. The results for cordless phone use were OR=1.7, 95% CI=1.1-2.9, and, for latency of 15-20 years, the OR=2.1, 95% CI=1.2-3.8. Few participants had used a cordless phone for >20-25 years. Digital type of wireless phones (2G and 3G mobile phones, cordless phones) gave increased risk with latency >1-5 years, then a lower risk in the following latency groups, but again increasing risk with latency >15-20 years. Ipsilateral use resulted in a higher risk than contralateral mobile and cordless phone use. Higher ORs were calculated for tumours in the temporal and overlapping lobes. Using the meningioma cases in the same study as reference entity gave somewhat higher ORs indicating that the results were unlikely to be explained by recall or observational bias.

This study confirmed previous results of an association between mobile and cordless phone use and

malignant brain tumours. These findings provide support for the hypothesis that RF-EMFs play a role both in the initiation and promotion stages of carcinogenesis.

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Abstract

We previously conducted a case-control study of acoustic neuroma. Subjects of both genders aged 20-80 years, diagnosed during 1997-2003 in parts of Sweden, were included, and the results were published. We have since made a further study for the time period 2007-2009 including both men and women aged 18-75 years selected from throughout the country. These new results for acoustic neuroma have not been published to date.

Similar methods were used for both study periods. In each, one population-based control, matched on gender and age (within five years), was identified from the Swedish Population Registry. Exposures were assessed by a self-administered questionnaire supplemented by a phone interview. Since the number of acoustic neuroma cases in the new study was low we now present pooled results from both study periods based on 316 participating cases and 3,530 controls. Unconditional logistic regression analysis was performed, adjusting for age, gender, year of diagnosis and socio-economic index (SEI).

Use of mobile phones of the analogue type gave odds ratio (OR) = 2.9, 95% confidence interval (CI) = 2.0-4.3, increasing with >20 years latency (time since first exposure) to OR = 7.7, 95% CI = 2.8-21. Digital 2G mobile phone use gave OR = 1.5, 95% CI = 1.1-2.1, increasing with latency >15 years to an OR = 1.8, 95% CI = 0.8-4.2. The results for cordless phone use were OR = 1.5, 95% CI = 1.1-2.1, and, for latency of >20 years, OR = 6.5, 95% CI = 1.7-26. Digital type wireless phones (2G and 3G mobile phones and cordless phones) gave OR = 1.5, 95% CI = 1.1-2.0 increasing to OR = 8.1, 95% CI = 2.0-32 with latency >20 years. For total wireless phone use, the highest risk was calculated for the longest latency time >20 years: OR = 4.4, 95% CI = 2.2-9.0. Several of the calculations in the long latency category were based on low numbers of exposed cases. Ipsilateral use resulted in a higher risk than contralateral for both mobile and cordless phones. OR increased per 100 h cumulative use and per year of latency for mobile phones and cordless phones, though the increase was not statistically significant for cordless phones. The percentage tumour volume increased per year of latency and per 100 h of cumulative use, statistically significant for analogue phones. This study confirmed previous results demonstrating an association between mobile and cordless phone use and acoustic neuroma.

<http://www.spandidos-publications.com/10.3892/ijo.2013.2025>

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Abstract

Background To study the association between use of wireless phones and meningioma.

Methods We performed a case–control study on brain tumour cases of both genders aged 18–75 years and diagnosed during 2007–2009. One population-based control matched on gender and age was used to each case. Here we report on meningioma cases including all available controls. Exposures were assessed by a questionnaire. Unconditional logistic regression analysis was performed.

Results In total 709 meningioma cases and 1,368 control subjects answered the questionnaire. Mobile phone use in total produced odds ratio (OR) = 1.0, 95% confidence interval (CI) = 0.7-1.4 and cordless phone use gave OR = 1.1, 95% CI = 0.8-1.5. The risk increased statistically significant per 100 h of cumulative use and highest OR was found in the fourth quartile (>2,376 hours) of cumulative use for all studied phone types. There was no statistically significant increased risk for ipsilateral mobile or cordless phone use, for meningioma in the temporal lobe or per year of latency. Tumour volume was not related to latency or cumulative use in hours of wireless phones.

Conclusions No conclusive evidence of an association between use of mobile and cordless phones and meningioma was found. An indication of increased risk was seen in the group with highest cumulative use but was not supported by statistically significant increasing risk with latency. Results for even longer latency periods of wireless phone use than in this study are desirable.

<http://www.ehjournal.net/content/12/1/60>

<http://www.prlog.org/12216483-brain-cancer-risk-increases-with-the-amount-of-wireless-phone-use-study.html>

Cell Phone Use, Acoustic Neuroma and Cancer of the Pituitary Gland

Cell phone use was associated with increased risk of two types of brain tumors in a new study of 790,000 women.

Joel M. Moskowitz, PRLog (Press Release), May 10, 2013

Cell phone use was associated with increased risk of acoustic neuroma and cancer of the pituitary gland in a prospective study of more than 790,000 women in the United Kingdom. (1)

Acoustic neuroma is a rare, non-malignant tumor that develops on the main nerve leading from the inner ear to the brain. The pituitary gland is an organ that produces hormones which regulate important functions of the body and is located in the middle of the base of the brain.

Women who used cell phones for ten or more years were two-and-a-half times more likely to develop an acoustic neuroma. Their risk of acoustic neuroma increased with the number of years they used cell phones.

The results for acoustic neuroma re-affirm one of the two major conclusions by the World Health Organization (WHO) in its recent monograph about radiofrequency electromagnetic fields and form the basis for classification of cell phone radiation as "possibly carcinogenic" to humans:

"Positive associations have been observed between exposure to radiofrequency radiation from wireless phones and glioma, and acoustic neuroma." (p. 421) (2)

The risk of cancer of the pituitary gland more was more than twice as high among women who used a cell phone for less than five years as compared to never users. Although the risk was elevated for women who used a cell phone for ten or more years (about 60% greater than never users), this effect was not significant. Since this may be the first study to find an association between cell phone use and pituitary cancer, further research on this cancer is necessary.

The women reported their cell phone use in 2005 to 2009 and again in 2009 and were followed through 2011 to see whether they developed tumors. The analyses controlled for other factors associated with tumor risk.

The study had numerous weaknesses which may explain why the research failed to replicate the increased risk of glioma associated with cell phone use of ten or more years found in several previous studies. Although this was a prospective study, the assessment of cell phone use was poor. Cell phone use was measured only at two time points and in a crude manner. The authors considered anyone who used a cell phone at least a minute per week to be a cell phone user. Although the authors measured the amount of cell phone use per week at follow-up, they did not report these results. The study did not assess cordless phone use or other microwave radiation exposures that are similar to cell phone emissions. If the never-cell phone users were cordless phone users, the effect of cell phone use on brain tumor risk would have been underestimated.

Since brain tumors can take decades to develop, the study underestimates the long term risk due to cell phone use as the average follow-up period for cell phone users was only seven years. Few women (about 8%) in this study used cell phones for ten or more years. Moreover, the women in this study may have used their cell phones much less than women do today.

The study was published online in the International Journal of Epidemiology on May 8, 2013. The authors are affiliated with the University of Oxford and the World Health Organization's International Agency for Research on Cancer.

For more information about electromagnetic radiation safety, see <http://saferemr.com>

Also see: U.K. Cell Phone Study Points to Acoustic Neuroma, Not Brain Cancer, Risk
<http://microwavenews.com/short-takes-archive/uk-study-points-acoustic-neuroma-not-glioma-risk>

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U.K. Cell Phone Study Points to Acoustic Neuroma, Not Brain Cancer Risk Fourth Study To Show Tumor Link; Is This Really Prospective Epidemiology?

Microwave News, May 10, 2013, Updated May 12, 2013

A [new study from the U.K.](#) is adding support to the still controversial proposition that long-term use of a cell phone increases the risk of developing [acoustic neuroma](#), a tumor of the auditory nerve. No higher risk of glioma or meningioma, two types of brain cancer, was observed.

Women who used a mobile phone for more than ten years were two-and-half-times more likely to have an acoustic neuroma than those who never used a phone. The finding is based on a smaller number of cases than the brain tumor results but is statistically significant. The U.K. epidemiological study is the fourth to show an association between long-term use of a cell phone and acoustic neuroma.

"[W]e did find a trend of increasing risk of acoustic neuroma with increasing duration of mobile phone use," according to the team led by [Victoria Benson](#), [Jane Green](#) and [Valerie Beral](#) of the University of Oxford. IARC's [Joachim Schüz](#), an avowed tumor risk skeptic, is a coauthor. The trend of more tumors with more phone use is also statistically significant. The paper is being published by the *International Journal of Epidemiology*; a copy was posted on its Web site on May 8th.

Without explanation, the increase in acoustic neuroma is omitted in the study conclusion presented in the published abstract. Only the lack of an association with brain cancer is reported there.

But perhaps the most controversial aspect of the new study is that it is being touted as "prospective." Prospective studies are considered superior to retrospective studies — such as [Interphone](#) — because they do not rely on people's memories to estimate past exposures. The fear with retrospective studies is that subjects with tumors, eager to explain their condition, will overestimate their cell phone use and skew the results in favor an association. In a prospective study, subjects fill out regular questionnaires detailing phone use and other possible changes over the span of the study.

It is true that the women were recruited into the U.K. study population before they developed a tumor and would not have had any incentive to misreport their phone use. But, beyond that, nothing about monitoring their radiation exposure could be called prospective. The U.K. study offers scant improvement over past efforts.

Calling the new study prospective cuts two ways. On the one hand, it gives additional support to the finding of no brain cancer from cell phones, but, on the other hand, it lends greater credibility to the acoustic neuroma association. This might explain the absence of the observed acoustic neuroma risk in the conclusion.

Exposure Assessment: "Crude" and "Extremely Limited"

"The evidence presented is less than a slam dunk," said [Joe Bowman](#), an industrial hygienist with the [U.S. NIOSH](#), who worked on the [Interphone study](#). "The exposure assessment in the new study was pretty crude and no attempt was made to estimate radiation exposure," he told *Microwave News* from his office in Cincinnati. "While it is better than in past retrospective studies in some ways, it is worse in others," he added. "For example, in Interphone, a user's entire phone history was obtained."

Cell phone use in the U.K. study was based on the answers to only one or two questions posed at the time the women were recruited for the study. They were asked, "About how often do you use a mobile

phone?" and were given three options: "never," less than once a day" and "every day." Those who did use a cell phone were also asked "for how long?" At the end of the study in 2009, participants were asked two more questions about their cell phone use, but those answers were not used in the data analysis.

"The study has extremely limited exposure assessment," concurred [Joel Moskowitz](#), an epidemiologist at the University of California, Berkeley. In 2009, Moskowitz published a [meta-analysis](#) pointing to a tumor risk from cell phones. In an interview, Moskowitz pointed out that the U.K. team had not collected any information on the use of cordless phones. "This could have been an important source of RF exposure," he said.

The Oxford paper also reports a higher than expected incidence of [tumors of the pituitary gland](#), but this increase is not statistically reliable.

Both the [Interphone project](#) and [Lennart Hardell's group](#) in Sweden have previously linked long-term cell phone use with acoustic neuroma, as did a [Japanese team](#) in 2010. The new paper does not cite the Japanese study.

Last fall, the [Italian Supreme Court ruled](#) in favor of such an association.

Two years ago, an expert panel convened by IARC classified [RF radiation as a possible human carcinogen](#). In April, IARC published the [rationale for the decision](#).

<http://microwavenews.com/uk-study-points-acoustic-neuroma>

Studies Show Cell Phone Use Increases Brain Cancer Risk

A newly published review of the research on mobile phone radiation and brain tumor risk calls on governments "to protect public health from this widespread source of radiation."

Joel M. Moskowitz, PRLog (Press Release), Jan 3, 2013

Dr. Lennart Hardell and his research group just published a review paper in the journal, Pathophysiology, that examined the evidence for brain tumor risk associated with wireless phone use (1, 2). The researchers conducted a meta-analysis in which data from previous studies were subjected to a systematic, quantitative analysis.

The authors reported that ...

"There is a consistent pattern of increased risk for glioma and acoustic neuroma associated with use of wireless phones (mobile phones and cordless phones) mainly based on results from case-control studies from the Hardell group and Interphone Final Study results." (1)

The meta-analysis found that the risk of glioma, a tumor which constitutes 80% of all malignant (i.e. cancerous) brain tumors, was 2.29 times greater on the side of the head where users held their phones among those who used mobile phones 1,640 or more hours in their lifetime (as compared to non-regular users). The corresponding risk for acoustic neuroma, a non-malignant tumor of the nerve that connects the ear to the brain, was similar—2.55 times greater. In contrast, the corresponding risk for meningioma, a tumor of the outer covering of the brain, was not significantly greater among regular cell phone users. (Over a ten year period, 1,640 hours would correspond to 27 minutes of cell phone use per day on average; however, many of those with brain tumors used their phones less than 10 years). (Over a ten year period, 1,640 hours would correspond to 27 minutes of cell phone use per day on average; however, many of those with brain tumors used their phones less than 10 years).

This review of the epidemiologic research is a follow up to a review sponsored by the International Agency for Research on Cancer (IARC) of the World Health Organization (WHO) in May 2011. After careful study of hundreds of scientific articles, thirty experts from fourteen countries classified cell phone radiation as "possibly carcinogenic to humans." The "Group 2B" classification was based largely on the Interphone Study which was conducted by investigators in thirteen countries, and the work of the Hardell research team.

In their review paper, Hardell and his colleagues argued that ...

"a causal association between use of mobile phone and glioma and acoustic neuroma comes from the meta-analyses as presented in this publication and also reviewed elsewhere. Supportive evidence comes also from anatomical localisation of the tumour to the most exposed area of the brain, cumulative exposure and latency time that all add to the biological relevance of an increased risk. In addition risk calculation based on estimated absorbed dose gives strength to the findings as well as the impact on survival of glioma patients relating to their use of mobile and cordless phones."

The Hardell paper also critically reviewed several flawed studies that have been published since the IARC review including the Danish cohort study and the CEFALO study.

The Hardell peer-reviewed paper noted that there are 5.9 billion cell phone subscriptions worldwide, and that “Many users are children and adolescents, which is of special concern regarding potential health effects.”

They cited the recent Italian Supreme Court ruling (3) and noted that based on the epidemiologic evidence ...

“... RF-EMF should be classified as a human carcinogen. “The current safety limits and reference levels are not adequate to protect public health. New public health standards and limits are needed.”

In the United States, the General Accountability Office issued a report this summer that called on the Federal Communications Commission to review our outmoded cell phone safety standards and testing procedures (4).

Also this summer, “The Cell Phone Right to Know Act” was introduced in the Congress. This bill calls for: (a) a review of cell phone safety standards by the Environmental Protection Agency, (b) adoption of a national research program to study cell phones and their effects on users’ health, and (c) publication of cell phone warning labels to alert users about the risks from cell phone radiation (5).

Cell phone radiation safety measures are long overdue. We called for similar measures in an op-ed in 2010 (6) following the publication of our 2009 research review (7).

A dozen nations have issued precautionary warnings about cell phones. It is time for the U.S. to act to protect the health of our population, especially children, adolescents, and pregnant women.

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<http://www.prlog.org/12052898-studies-show-cell-phone-use-increases-brain-cancer-risk.html>

Your Cell Phone Company May Affect Your Risk of Brain Cancer

Regardless of your carrier, always keep your cell phone away from your head and your reproductive organs. Children's cell phone use should be very limited.

Joel M. Moskowitz PRLog (Press Release), Mar 27, 2013

A new study found that the average amount of microwave radiation your head absorbs when you use your cell phone for voice communications is greater if your phone company employs GSM technology (i.e., AT&T or T-Mobile) than if it uses CDMA technology (i.e., Verizon or Sprint):

"... the dominant factor for SARs during use is the time-averaged antenna input power, which may be much less than the maximum power used in testing. This factor is largely defined by the communication system; e.g., **the GSM phone average output can be higher than CDMA by a factor of 100.**" (1)

The Telecom industry and consumer organizations ignore cell phone carrier differences and focus only on the Specific Absorption Rate or SAR of different cell phone models when they provide precautionary safety information to the public.

SAR is the maximum amount of energy absorbed in 1 gram of tissue in a simulated model of a large male adult's head in a laboratory setting. However, under normal use, your cell phone company may matter more in terms of your microwave radiation exposure than which cell phone you own.

The Federal government regulates cell phones based on the SAR. The maximum legal SAR, 1.6 watts per kilogram of tissue, established in 1996, protects users from overheating body tissue. However, it does not protect users from the subthermal, harmful effects observed in hundreds of laboratory studies. The government needs to establish a biologically-based safety standard for microwave radiation.

Although the Telecom industry has known for over a decade that GSM emits more microwave radiation under normal use than CDMA, the public has been kept in the dark. Perhaps, this is because such knowledge could have major ramifications for the industry should people decide to switch cell phone companies to reduce their microwave radiation exposure.

The new study was published online in the journal, ***Bioelectromagnetics***, by Sven Kuehn and four colleagues who are employed by several industry technical organizations. The U.S. Food and Drug Administration (FDA) provided technical oversight to this study which was funded by the CTIA—The Wireless Association.

(Side note: CTIA spokespersons have argued in legislative hearings in the U.S. that they do not fund research.)

Two years ago, I issued a news release based on the available research because I was concerned that people who use GSM cell phones may be at greater risk for brain cancer. Also, I wanted to encourage the Federal government to fund comparative health effects studies on the different carrier technologies. Although there was some media coverage of this story (2-4), no new research studies were funded.

Following are key points from my 2011 news release:

- Currently in the U.S., we can choose between two 2G technologies for voice communication: CDMA and GSM. CDMA phones (e.g., Verizon, Sprint) emit less radiation on average than GSM phones (e.g., AT&T, T-Mobile). A study conducted in the San Francisco Bay Area found that GSM phones emitted 28 times more radiation on average than CDMA phones (Kelsh et al, 2010). Cardis et al (2011) assumed that GSM phones emit 15 times more radiation on average than CDMA phones based on Canadian research.

In contrast, the highest SAR phones available in the U.S. have a maximum SAR that is about eight times greater than the lowest SAR phones. Hence, the cell phone carrier may matter more than the cell phone model in terms of average exposure to cell phone radiation.

- Perhaps, even more importantly, unlike CDMA, GSM is pulsed at extremely low frequencies (217 Hertz, 8 Hertz and 2 Hertz) which may increase its bioactivity. In 2001, the International Agency for Research on Cancer of the World Health Organization classified this extremely low frequency electromagnetic radiation (EMR) (3-3000 Hertz) as a possible carcinogen (Group 2B).

- In 2011, the IARC classified cell phone radiation as a possible carcinogen (Group 2B) based heavily on human studies of glioma risk. The exposures in these studies were largely due to analog and GSM technology and not CDMA technology.

Thus, we have two reasons to be concerned that GSM phones are more likely to be bioactive compared to CDMA: greater average power output and emission of extremely low frequency EMR.

- A review of toxicology study abstracts that examined 2G technology found that 43% (n=16) of 37 GSM studies reported bioactivity as compared to 15% (n=5) of 33 CDMA studies.

After the IARC 2011 meeting, news stories cited Robert Bann of IARC who stated that 3G technology emits 100 times less energy than 2G technology. He implied that 3G may be much safer than 2G. However, ...

- A review of toxicology study abstracts that examined 3G technology found that 30% (n=6) of 20 UMTS studies reported bioactivity as compared to 0% (n=0) of 9 W-CDMA studies. UMTS is the successor to GSM, and W-CDMA is the successor to CDMA. 3G does **not** appear to be safer than 2G. Again, the specific carrier technology seems to matter greatly.

- I did not find any studies that examined the health effects of 4G technology. Yet, the major cellular companies plan to move voice communications to 4G (i.e., LTE) in the near future despite the absence of health studies.

Although the evidence may still be circumstantial, some cell phone carrier systems appear to be safer than others. We need to provide precautionary health warnings to the public to promote harm reduction.

Finally, the government should fund a major research program to develop biologically-based safety standards and safer wireless technologies. A nickel a month cell phone fee could generate \$180 million per year in funding for research on wireless technologies.

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**Cellphones Can Increase Brain Cancer Risk in Children |
"Scientists Challenge No Risk Conclusion"**

This study provided evidence that children and adolescents have a substantial risk of brain cancer from cellphone use and that the time between first use and diagnosis of the cancer may be quite short.

Joel M. Moskowitz, PRLog (Press Release), Apr 5, 2012

Last July, the first study of the risk of brain cancer associated with cellphone use among children and adolescents was published in the Journal of the National Cancer Institute. The study (<http://jnci.oxfordjournals.org/content/early/2011/07/27/jnci.djr244.abstract>) concluded that,

"The absence of an exposure–response relationship either in terms of the amount of mobile phone use or by localization of the brain tumor argues against a causal association."

Today, the Journal published Letters to the Editor (Correspondences) by highly respected scientists that refute this conclusion and makes it clear that the published findings, in contrast to the authors' cryptic conclusion, indicates a serious risk of brain cancer associated with cellphone use.

These Letters to the Editor also pointed out multiple examples of contradictory data that implied that the peer review was inadequate

For example, using cellphone billing records (which do not rely on the children's memory of their cellphone use) the study found a statistically significant 115% increased risk of brain cancer after more than 2.8 years since they first had a cellphone subscription. The study also reported a 99.9% of confidence that the more the cellphone was used, the higher the risk of brain cancer (indicating a dose-response relationship).

One example of these contradictory data was: the reported percentages of children with billing records would mean that there should be 123 children with brain cancer (cases), and 200 children without brain cancer (controls). Yet the table that reported the number of cases and controls listed 196 cases and 360 controls. It is surprising that peer reviewers would not have noted this contradiction.

When the study was published, Dr. Joel Moskowitz, from the School of Public Health at the University of California—Berkeley commented,

"In my opinion, the interpretation of the results from this study and the accompanying editorial were biased in an attempt to reduce concerns that cell phone use increases brain tumor risk among children and adolescents."

The Cleveland Plain Dealer quoted Moskowitz,

"They did report a number of significant associations between cell phone use, in terms of number of years of use, with brain tumor risk in children, and they try to dismiss those, as well."

Dr. Sam Milham in his Correspondence writes,

"If, as the authors ... conclude, mobile phone use is not associated with brain cancer in children ..., there should be as many odds ratios greater than 1 as the number of odds ratios less than 1.1 In table 2, all of the 13 calculated odds ratios are greater than 1.0. ..." and goes on to show

similarly skewed odds ratios in other tables.

Last December another highly respected group of researchers published a Commentary (<http://www.ehjournal.net/content/10/1/106>) in the journal Environmental Health. They stated,

“... in spite of low exposure, short latency period and limitations in study design, analyses and interpretation, there are nevertheless indications of increased risk in [the study].”

In sum, this study provided evidence that children and adolescents have a substantial risk of brain cancer from cellphone use and that the time between first use and diagnosis of the cancer may be quite short.

L. Lloyd Morgan, Environmental Health Trust
Devra Davis, Ph.D, MPH, Founder Environmental Health Trust
Ronald B. Herberman, MD, Environmental Health Trust & Intrexon Corp
Alasdair Philips, Founder Powerwatch UK

<http://www.prlog.org/11843017-cellphones-can-increase-brain-cancer-risk-in-children-scientists-challenge-no-risk-conclusion.html>

<http://electromagnetichealth.org/electromagnetic-health-blog/cell-phone-cancer-risk-children/>

Cell Phones and Cancer: Critics Say Kids Risk Brain Tumors

Carrie Gann, ABC News Medical Unit, *ABC Good Morning America*, Apr 5, 2012

Scientists are calling into question a study published last year that failed to find a link between cell phone use and brain tumors in children and teens. They say the study actually shows that cell phone use more than doubles the risk of brain tumors in children and adolescents.

The concerns come from the Environmental Health Trust, a group whose stated mission is to promote awareness of environmental issues they believe are linked to cancer.

In July 2011, the [Journal of the National Cancer Institute published](#) the first study on cellphone use and risk of brain tumors in children and adolescents, which was conducted by researchers at the Swiss Tropical and Public Health Institute. The scientists interviewed children and teens in Norway, Denmark, Switzerland and Sweden about their cell phone use and also collected cell phone records for a portion of them. Of the children studied, 350 had been diagnosed with brain cancer and 650 of them were healthy.

The July paper concluded that the data showed no link between cell phone use and brain tumors and "argues against a causal association" between the two.

In a letter published today in the journal, the Environmental Health Trust said the interpretation of the study's results was flawed and contained several statistical errors.

Lloyd Morgan, a senior research fellow at the Environmental Health Trust and one of the authors of the letter, called the study "sloppy" and said the data reported in the original study actually shows that children who used cell phones had a 115 percent increased risk of brain tumors over those who did not.

"There's every indication that this study actually found that children have a doubled risk of brain cancer," Morgan said. "For them to just state that we don't think there's a problem is, for me, quite mystifying."

Messages to the journal and the authors of the original study asking for comment were not returned.

The authors of the original study do note some limitations of their work, including that a relatively small number of children were studied. They also wrote that they could not "rule out the possibility that mobile phones confer a small increase in risk."

International concern over the potential health risks posed by cell phones has gone on for years. In May, the World Health Organization's International Agency for Research on Cancer put the devices in the same category as lead and engine exhaust, citing the possibility that long-term exposure to cell phone radiation could have long-term health effects. Roughly 30 studies so far have failed to draw a conclusive link.

In October, the Environmental Health Trust also [criticized the test](#) used by the Federal Communications Commission to measure cellphone radiation, saying the measure did not accurately reflect the radiation transmitted to children and adults while using cell phones.

Concerns over risks to children are particularly heightened, considering the rising use of cell phones among kids and teens and the fear that children's developing brains might be more susceptible to the effects of cellphone radiation.

However, only two studies so far have investigated the link between brain tumors and cell phone use specifically among young people -- one is the disputed study, and the other is a [research project](#) currently underway in 13 countries.

Joel Moskowitz, director of the Center for Family and Community Health at the University of California-Berkeley's School of Public Health, said current evidence showing a link between cell phone radiation and cancer risk is enough for him to say scientists should not dismiss concerns.

"You can't prove that it's cell phone radiation, but we certainly have a smoking gun," Moskowitz said.

Dr. Michael Thun, vice president emeritus of epidemiology and surveillance research for the American Cancer Society, said because cell phones are a fairly new phenomenon, no one really knows just what their health effects are yet, but he sees no evidence to support the concerns voiced by the Environmental Health Trust.

"The issue of whether cell phones do have adverse effects is an important one and needs further surveillance, but I don't find this particular letter to be very compelling," Thune said.

Experts agree that all cell phone users, regardless of age, can take steps to minimize any potential risks, such as keeping phones a moderate distance away from the head and body and using headsets or earpieces instead of placing the phone next to one's head.

Tips for Reducing Your Exposure to Cellphone Radiofrequency (RF) Radiation

Use a headset. RF waves are transmitted through the phone's antenna, so avoid placing the antenna against your head.

Use a landline phone when you can.

Minimize the length of your calls, or send an email or text.

Cell phones send out more RF waves when they are searching for a signal, so during those times, keep the device away from you or turn it off.

A little distance goes a long way. Doubling your distance from the phone cuts your risk by 75 percent.

Some manufacturers claim cell phone radiation shields can protect users from the effects of your cell phone's RF waves, but according to the FCC, the devices aren't proven to be effective. In fact, using these devices could increase your exposure to RF, because your phone has to work harder to overcome the physical barrier.

<http://gma.yahoo.com/cell-phones-cancer-critics-kids-risk-brain-tumors-212955668--abc-news-health.html>

A close call: Why the jury is still out on mobile phones

Is a rise in brain tumours linked to the radiation sources we hold so close to our heads? Experts can't agree on the answer

Nina Lakhani, *The Independent* (London), Apr 24, 2012

Allegations of lobbying, bad science, not enough science, conflicts of interest, political inertia, scaremongering and lawsuits: the debate surrounding the safety of mobile phones has it all. With more than 5 billion users worldwide, mobile phones have undoubtedly become central to modern life in just two decades, but could they be a health hazard?

Scientists at the Children with Cancer conference in London this week will advocate that governments adopt the 'precautionary principle' – advising phone users to take simple steps to protect themselves and their children from potential, not proven, long term health risks of electromagnetic fields - especially head cancers.

They will call for urgent research into new Office of National Statistics figures that suggest a 50 per cent increase in frontal and temporal lobe tumours – the areas of the brain most susceptible to the electromagnetic radiation emitted by mobile phones – between 1999 and 2009.

Caroline Lucas, MP for Brighton Pavilion and Green Party leader, will next week table an Early Day Motion calling for mandatory safety information at the point of sale, and for widely publicized advice, for young people in particular, to text, use headsets or corded landlines for long calls.

But the Health Protection Agency's new report on the "potential health effects" on mobile phone technologies on Thursday is likely to conclude that there is only one established risk, and that is crashing the car if people talk and drive.

The scientists cannot agree, so what should the public be told?

The Department of Health currently has a confusing online-only leaflet which states that there is no immediate concern but under-16s should be encouraged to minimise phone use and if concerned about risks, choose hands free kits or texting.

In stark contrast France has banned phones from primary schools and advertising targeted at children, and companies must provide headsets with every phone.

Israel recently became the latest of a very small, but growing number of governments to introduce legislation requiring all mobile phones and adverts to come with a health alert: "Warning – the Health Ministry cautions that heavy use and carrying the device next to the body may increase the risk of cancer, especially among children."

The law, which last month passed its first reading, also seeks to ban, like with tobacco, companies from marketing to children.

An attempt by San Francisco's lawmakers to require similar health warnings is being vigorously fought by the industry on the grounds it would violate the companies' first amendment rights.

Professor Darius Leszczynski, from the Radiation and Nuclear Safety Authority in Finland, has warned about possible health hazards of mobile phones for more than a decade. He was one of 30 experts at the International Agency for Research on Cancer [IRAC], the global authority on cancer risks, who last year concluded mobile phones radiation is “possibly carcinogenic”. (Other scientists disagree entirely.)

Leszczynski will tell conference delegates that there is enough laboratory evidence to support an even stronger classification of ‘probably carcinogenic’. He said: “Since 2001 I have continuously spoken about the need for precautionary measures, especially for children. We have had enough evidence to call for that for a long time.”

Dr Annie Sasco from the Epidemiology for Cancer Prevention unit at Bordeaux Segalen University is at the conference discussing the 1 to 2 per cent annual increase in childhood brain cancers.

“It’s not age, it’s too fast to be genetic, and it isn’t all down to lifestyle, so what in the environment can it be? We now live in an electro-smog and people are exposed to wireless devices that we have shown in the lab to have a biological impact. It makes sense that kids are more sensitive – they have smaller heads and thinner skulls, so EMFs get into deeper, more important structures.

“It is totally unethical that experimental studies are not being done very fast, in big numbers, by independently funded scientists. The industry is just doing their job, I am more preoccupied with the so called independent scientists and institutions saying there is no problem.”

The rate of frontal and temporal brain tumours has risen from two to three per 100,000 people in a decade. Denis Henshaw, Emeritus Professor of Human Radiation Effects at the University of Bristol, said: “The public have a right to know this information. We cannot and do not say there is a causal link between brain cancer and mobile phones, but we are right to consider them as one possible explanation for the increase and the public have the right to expect that this is properly investigated.”

He added: “Even if the risk is still only one in a million, with 5 billion phone users, it means a lot of extra brain cancers.”

The UK’s Mobile Operators Association says that most health agencies agree that there is “no credible evidence of adverse health effects from mobile phone technology.”

Yet buried in the small print, companies issue precautionary advice.

For example, BlackBerry’s booklet states: “use hands-free operation if available and keep the BlackBerry device at least 0.98in (25mm) from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry is turned on and connected to the wireless network... reduce the amount of time spent on calls.”

The iPhone4 guide says: “...when using the iPhone near your body for voice calls or wireless data transmission over a cellular network, keep it at least 5/8inch (15mm) away from the body, and only use carrying cases, belt clips or holders that do not have metal parts and that maintain at least 5/8inch (15mm) separation between iPhone and the body.”

And in 2009 the European Parliament said it was “... greatly concerned that insurance companies are tending to exclude coverage for the risks associated with EMFs from the scope of liability insurance policies, the implication clearly being that European insurers are already enforcing their version of the precautionary principle.”

The research is split almost 50:50, on whether mobile phones pose a health hazard or not. But the balance changes if funding sources are considered, with around three quarters of the 'negative' studies - no health risks - funded by industry, according to analysis by Joel Moskowitz, director of the Center for Family and Community Health at the University of California, Berkley.

Anthony Swerdlow, professor of epidemiology at the Institute of Cancer Research and chair of the HPA's Advisory Group on Ionizing Radiation – behind next week's report, said: "Individual results from particular studies have shown there is a link but in order to believe there is an established effect, it needs to be shown consistently across the literature.

"There are no established ill-effects from cell phones other than the genuine and serious hazard of driving while talking due to poor concentration. I don't think any causes of cancer have been established. If there are very long term effects we don't know it yet. Long term effects from childhood use are also largely unknown, but we don't have reason to believe there are ill-effects."

Most current studies are at least part funded by industry, or involve researchers with industry links.

Moskowitz said: "The mantra that 'we need more research' is true, but there is already enough evidence to warrant better safety information, tighter regulation, mass public education and independently funded research carried out by teams of specialists who are not beholden to industry.

"This is the largest technological experiment in the history of our species and we're trying to bury our head in sand about the potential risks to cells, organs, reproduction, the immune system, behaviour, risks we still know next to nothing about.

Campaigners had hoped that IRAC's "possibly carcinogenic" classification in 2011 would trigger public health warnings.

Instead, most governments emphasised the need for more research, largely without committing any funds, even though simple steps like texting, using hands free devices, better phone design and not carrying phones next to the body, significantly reduce exposure to EM radiation.

Campaigners claim that the mute response can partly be blamed on industry successfully spinning the message as good news, a claim which the Mobile Operator's Association vehemently denies.

In December 2010, MP Tom Watson said in parliament: "It is my view that the more an industry or organisation wishes to hide something unpleasant or do something unpopular, the more lobbyists it employs to talk to MPs. The \$1 trillion telecoms industry hires a lot of lobbyists."

Industry has been accused of trying to discredit and marginalise scientists who produce 'unfavourable' results for almost 20 years.

In 1995, Professor Henry Lai, a bioengineering researcher at the University of Washington, accidentally discovered that exposing rats to microwave radiation, the same type emitted by phones, damaged the DNA in their brain cells. He has publicly described industry efforts to discredit his work and stop him working in the field as "scary".

A decade later the EU funded Reflex study found that EMF radiation had the potential to cause genetic damage in human cells, at much lower levels than considered safe by regulators.

High-profile efforts to discredit the study by one scientist alleging scientific fraud followed, and despite being dismissed by an ethics committee, the smear campaign stuck, according to Professor Franz Adlkofer, coordinator of Reflex.

Adlkofer said: "The poor state of knowledge is due to selective funding of research through governments and telecommunication industry combined with the willingness of hired scientists to adjust their findings to the needs of the awarding authorities, while the governmental blindness is the result of lobbyism in the antechambers of political power. National governments and international industries have in common that they only trust the false messages of scientists they co-operate with, and not the contradicting data of researchers like me."

Despite the controversies and disagreements, the European Environment Agency suggests governments learn from previous public health failures such as tobacco and asbestos where better regulation came decades after the first medical warnings about lung cancer.

John Cooke, Executive Director Mobile Operators Association, disagrees: "There is no evidence to suggest that warning labels for mobiles are warranted. In fact, there is good evidence that the proliferation of warnings about risk, where there is no good evidence for such risk, is counter-productive and is bad for public health. Industry funds research. It's morally the right thing to do and governments ask us to do it... industry does not set or control the research agenda. Alleging undue influence and conspiracy theories impugns the integrity of scientists, and is the last refuge of the desperate who have lost the argument based on the facts."

Vicky Fobel from campaign group MobileWise said: "This latency problem is what caused so many unnecessary deaths from smoking and asbestos. We need to learn from those mistakes and take steps now before it's too late. That more research is needed shouldn't be an excuse for inaction."

A DH spokeswoman said: "As a precaution children should only use mobile phones for essential purposes and keep all calls short. We keep all scientific evidence under review."

Facts

5 billion Number of mobile phones in use around the world

50% The 10-year rise in tumours located in areas of the brain most vulnerable to mobile phone radiation

25mm Distance that BlackBerry recommends keeping its phones away from the body

16 The age under which people are advised by the NHS to keep mobile use to a minimum

Always read the small print: Official advice

Research is split on whether mobile phones pose a health hazard or not. Buried in the small print, companies already issue precautionary advice.

BlackBerry

BlackBerry's booklet states: "Use hands-free operation if available and keep the BlackBerry device at least 0.98in (25mm) from your body (including the abdomen of pregnant women and the lower abdomen

of teenagers) when the BlackBerry is turned on and connected to the wireless network... reduce the amount of time spent on calls."

iPhone

The iPhone4 guide says: "...when using the iPhone near your body for voice calls or wireless data transmission over a cellular network, keep it at least 5/8inch (15mm) away from the body, and only use carrying cases, belt clips or holders that do not have metal parts and that maintain at least 5/8inch (15mm) separation between iPhone and the body."

UK Department of Health

A spokeswoman says: "As a precaution children should only use mobile phones for essential purposes and keep all calls short. We keep all scientific evidence under review."

<http://www.independent.co.uk/life-style/gadgets-and-tech/news/a-close-call-why-the-jury-is-still-out-on-mobile-phones-7670543.html>

'The biggest experiment of our species': With five billion mobile users in the world, conference calls for research into potential brain cancer risk

- Scientists at London conference call for independent research into potential links between using a mobile phone and brain cancer
- Figures from ONS show 50 per cent increase in brain tumours since 1999
- Studies 'are split 50/50' in conclusions, leaving the issue open for debate
- But believers fear fall-out from the 'biggest technological experiment in the history of our species'

Eddie Wrenn, *Daily Mail* (London), Apr 24, 2012

A scientific conference starting in London today will urge governments across the world to support independent research into the possibility that using mobile phones encourages the growth of head cancers.

The Children with Cancer conference will highlight figures just published by the Office of National Statistics, which show a 50 per cent increase in frontal and temporal lobe tumours between 1999 and 2009.

The ONS figures show that the incident rate has risen from two to three per 100,000 people since 1999, while figures from Bordeaux Segalen University show a one to two per cent annual increase in brain cancers in children.

Scientists and academics have long argued over the suggestion that radiation from mobile phones causes cancers. Those who believe there is a link say that - with five billion mobile phones being used worldwide - urgent research must be carried out to establish the risk.

But not everyone agrees. While governments, phone companies, and health agencies give precautionary advice about minimising mobile phone use, the Health Protection Agency is likely to conclude in a report due on Thursday that the only established risk when using a mobile is crashing a car due to being distracted by a call or text.

Professor Denis Henshaw, emeritus professor of human radiation effects at Bristol University, is opening the three-day conference in Westminster today.

He has previously advocated cigarette-style warnings on mobile phone packets and urges more independent research.

Professor Henshaw said: 'Vast numbers of people are using mobile phones and they could be a time bomb of health problems - not just brain tumours, but also fertility, which would be a serious public health issue.'

'The health effects of smoking alcohol and air pollution are well known and well talked about, and it's entirely reasonable we should be openly discussing the evidence for this, but it is not happening.'

'We want to close the door before the horse has bolted.'

The International Agency for Research on Cancer (IARC) rang alarm bells last year when it classified mobile phones as 'possibly carcinogenic'.

Professor Darius Leszczynski, of the Radiation and Nuclear Safety Authority in Finland, said: 'For the first time a very prominent evaluation report states it so openly and clearly: RF-EMF [radio frequency electromagnetic field] is possibly carcinogenic to humans.'

'One has to remember that IARC monographs are considered as "gold standard" in evaluation of carcinogenicity of physical and chemical agents.'

'If IARC says it so clearly then there must be sufficient scientific reason for it, or IARC would not put its reputation behind such claim.'

However not everyone believes there is a significant risk from mobile phone radiation.

Ken Foster, professor of bio-engineering at the University of Philadelphia, downplayed the IARC's classification.

He is quoted on [Science Based Medicine](#) as saying: 'Saying that something is a "possible carcinogen" is a bit like saying that someone is a "possible shoplifter" because he was in the store when the watch was stolen.'

'The real question is what is the evidence that cell phones actually cause cancer, and the answer is - none that would persuade a health agency.'

The Independent said the research is split almost 50:50 on whether mobile phones pose a health hazard or not, but pointed out research from Joel Moskowitz, director of the Center for Family and Community Health at the University of California, who said that the balance changes if funding sources are considered, with around three quarters of studies implying no health risks being funded by the mobile phone industry.

He told the paper: 'The mantra that "we need more research" is true, but there is already enough evidence to warrant better safety information, tighter regulation, mass public education and independently funded research carried out by teams of specialists who are not beholden to industry.'

'This is the largest technological experiment in the history of our species and we're trying to bury our head in sand about the potential risks to cells, organs, reproduction, the immune system, behaviour, risks we still know next to nothing about.'

Governments and mobile phone companies often play down the risks and the UK's Mobile Operators Association says there is 'no credible evidence of adverse health effects'.

The Department of Health says: 'As a precaution children should only use mobile phones for essential purposes and keep all calls short. We keep all scientific evidence under review.'

The NHS also advises children under 16 to minimise their use of mobile phones.

The iPhone, Apple's smartphone which popularised mobile computing, comes with the advice that you should keep your phone at least 15mm away from your body at all times - which may come as a surprise to those who keep the phone in the their pockets at all times.

The guide that comes with the phone warns: 'When using the iPhone near your body for voice calls or wireless data transmissions over a cellular network, keep it at least 15mm away from the body, and only use carrying cases, belt clips or holders that do not have metal parts and that maintain at least 15mm separation between iPhone and the body.'

Other guides, such as the one that comes with a BlackBerry, have similar warnings. The BlackBerry guide suggests that users, particularly pregnant women and teenagers, keep their phone 25mm from their body.

The guide, almost ironically, also suggest that users 'reduce the amount of time spent on calls'.

Professor Leszczynski will use the conference to urge for a stronger IARC classification - 'probably carcinogenic'.

He told the Independent: 'Since 2001 I have continuously spoken about the need for precautionary measures, especially for children. We have had enough evidence to call for that for a long time.'

The conference will also discuss other reasons for childhood cancer, such as chemical toxins in the air, food and water, and infection and genetic effects.

But the main message coming from the Children with Cancer conference is: more independent research is needed.

Professor Denis Henshaw told the Independent: 'The public have a right to know this information.

'We cannot and do not say there is a causal link between brain cancer and mobile phones, but we are right to consider them as one possible explanation for the increase and the public have the right to expect that this is properly investigated.

'Even if the risk is still only one in a million, with 5 billion phone users, it means a lot of extra brain cancers.'

The conference can be streamed online at www.childhoodcancer2012.org.uk

CANCER IN CHILDREN ON THE RISE

Speaker Dr Annie Sasco, from the Epidemiology for Cancer Prevention unit at Bordeaux Segalen University, will highlight the one to two per cent annual increase in brain cancers in children.

She has concerns over the effect of radiation on children's brains.

She said: 'If the penetration of the electromagnetic waves goes for four centimetres into the brain, four centimetres into the adult brain is just the temporal lobe.

'There are not too many important functions in the temporal lobe - but in a child the more central brain structures are going to be exposed.

'In addition kids have a skull which is thinner, less protective, they have a higher content of water in the brain, so there are many reasons that they absorb more of the same radiation.'

Speaking to the Independent about the rise in brain cancer in children, she said: 'It's not age, it's too fast to be genetic, and it isn't all down to lifestyle, so what in the environment can it be?

'We now live in an electro-smog and people are exposed to wireless devices that we have shown in the lab to have a biological impact.

'It is totally unethical that experimental studies are not being done very fast, in big numbers, by independently funded scientists.

'The industry is just doing their job, I am more preoccupied with the so called independent scientists and institutions saying there is no problem.'

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WHAT IS THE RISK? STUDY OF 350,000 PEOPLE FAILS TO FIND CANCER LINK

A study held in Denmark last October compared medical records against phone records of around 358,000 people.

They correlated the data to see how long people owned their phones, and how many of these people developed brain cancer. Some users had owned mobile phones for more than 20 years.

In total, the group had owned their phones for '3.8 million years', and suffered 10,729 cases of tumours.

When compared to the average population, they found no indication of 'dose-response' relation either by years since first subscription for a mobile phone or by anatomical location of the tumour - that is, in regions of the brain closest to where the handset is usually held to the head.

They concluded 'there were no increased risks of tumours of the central nervous system, providing little evidence for a causal association'.

<http://www.dailymail.co.uk/news/article-2134382/Risks-biggest-technological-experiment-history-species-Calls-research-links-using-mobile-phones-brain-cancer.html>

Radiation from mobile phones: Tumour rumours return

TelecomTV One, Apr 25, 2012

Over past years reports upon reports have been published claiming to prove either that radiation from mobile handsets does cause brain cancers or that it doesn't. Basically you read the research, meld it with your personal prejudices pro or con the arguments and take a stance accordingly. For, in the house of mobile technology there are many mansions peopled by apologists for one side or the other, as Martyn Warwick reports.

Yesterday, London saw the launch of the three-day "Children With Cancer" conference whereat scientists and medics are calling for yet more "completely objective and independent" research to be carried out into this emotive subject. That's apparently because all the studies undertaken to date "are split 50:50" in concluding that mobiles do/do not cause cancers.

The conference is being held shortly after new figures from Britain's Office of National Statistics(ONS) show that in the UK there was a big increase in the incidence of frontal and temporal lobe brain tumours between 1999 and 2009, with many delegates believing the mass uptake of mobiles over that decade is hardly co-incidental to the rise in cancer cases.

The new UK figures indicate that the rate of incidence of brain tumours associated (in some people's belief and in some research results) with the use of cellphones rose from two in 100,000 in 1999 to three in 100,000 in 2009 - that's a 50 per cent increase and as such is statistically highly significant.

Meanwhile, in France, independent research carried out at Segalen University in Bordeaux also shows that the incidence of brain cancers in children under the age of 15 has risen by between one and two per cent annually over the past decade and this too, it is claimed, is linked to the use of mobile phones.

Dr Annie Sasco from Segalen University says of the increased incidence of brain cancers, "It's not age, it's too fast to be genetic, and it isn't all down to lifestyle, so what in the environment can it be? We now live in an electro-smog and people are exposed to wireless devices that we have shown in the lab to have a biological impact. It makes sense that kids are more sensitive – they have smaller heads and thinner skulls, so EMFs get into deeper, more important structures."

The Children with Cancer Conference says national governments should apply the "precautionary principle" with regard to mobiles and provide their citizens with "sensible" advice about the possible health risks associated with the prolonged and continual use of cellphones.

Some sort of coherent approach to the issue is needed because things are all over the place at the moment. For example, in the UK, an online posting by the Department of Health says there is no health risk allied to the use of mobiles, but also advises that children under the age of 16 shouldn't be allowed to spend too long on their phones and adds that if parents are worried about cancer scares, their offspring should be "encouraged" to go "hands-free" and use headsets!

Meanwhile, across the Channel in France, mobile are totally banned from primary schools, TV and other advertising of mobile phones, apps and services aimed at children is illegal and vendors must provide a headset with each and every handset sold.

Elsewhere, several countries (Israel being the latest) have passed laws requiring all mobile phone

advertising and all handsets and devices to carry a "health alert" not dissimilar to the cancer warnings printed on cigarette packets.

The Israeli alert says, "Warning – the Health Ministry cautions that heavy use and carrying the device next to the body may increase the risk of cancer, especially among children."

Some scientists and cancer specialists are concerned because about 75 per cent of research projects that have concluded that radiation emanating from mobile comms devices is not detrimental to human health have been, at least in part, funded by vested interests within the industry itself or have had industry insiders on the research teams. Many of these reports end by saying that yet more research is needed before an informed judgement can be made - and on ad infinitum

Dr. Joel Moskowitz, the Director of the Centre for Family and Community Health, which is part of the School of Public Health at the University of California, says, "The mantra that 'we need more research' is true, but there is already enough evidence to warrant better safety information, tighter regulation, mass public education and independently funded research carried out by teams of specialists who are not beholden to industry".

Meanwhile, Denis Henshaw, Emeritus Professor of Human Radiation Effects at the University of Bristol, says "We cannot and do not say there is a causal link between brain cancer and mobile phones, but we are right to consider them as one possible explanation for the increase and the public have the right to expect that this is properly investigated. Even if the risk is still only one in a million, with 5 billion phone users, it means a lot of extra brain cancers."

It is also interesting to speculate just why, if there absolutely is no connection of any sort between mobile radiation and tumours, the likes of Apple and RIM go to the bother of providing some advice (albeit in the small print of their user handbooks and documents) about, literally, maintaining a distance between oneself and an iPhone or BlackBerry.

For example, the iPhone 4 guide advises "when using the iPhone near your body for voice calls or wireless data transmission over a cellular network, keep it at least 5/8inch (15mm) away from the body, and only use carrying cases, belt clips or holders that do not have metal parts and that maintain at least 5/8inch (15mm) separation between iPhone and the body."

Meanwhile, RIM says BlackBerry owners should "use hands-free operation if available and keep the BlackBerry device at least 0.98in (25mm) from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry is turned on and connected to the wireless network."

Dr. Moskowitz comments, "This [mobile telephony] is the largest technological experiment in the history of our species and we're trying to bury our head in sand about the potential risks to cells, organs, reproduction, the immune system, behaviour - risks we still know next to nothing about."

Critics say that mobile industry bodies and associations around the world devote much time and many resources to putting a positive spin on those pieces of research claiming that there is no evidence that radiation from mobile devices can cause illness while either ignoring, ridiculing, discrediting and traducing the results of research that does indicate a correlation between mobile radiation and tumours.

Speaking in the UK's House Of Commons in December 2010, the MP Tom Watson, (who is now rather famous for being a major thorn in the side of News Corp and the Murdoch media empire), commented, "It is my view that the more an industry or organisation wishes to hide something unpleasant or do

something unpopular, the more lobbyists it employs to talk to MPs. The US\$1 trillion telecoms industry hires a lot of lobbyists.” That observation holds true to this day.

http://www.telecomtv.com/comspace_newsDetail.aspx?n=48650&id=e9381817-0593-417a-8639-c4c53e2a2a10

The Million Women Study ... shoddy design ... shoddy results ... shoddy conclusions

Dariusz Leszczynski, *Washington Times Communities*, Oct 3, 2013

HELSINKI, Finland, October 3, 2013 —The only two epidemiological cohort studies in existence examining the link between cell phone radiation exposures and brain cancer have embarrassingly poor design.

The two cohorts were established in Denmark and in UK. The original purpose was not to study cell phone radiation effects but other health problems. At some point in designing cohorts, scientists decided to ask questions about cell phone use and, as an aside, to examine brain cancer risk.

The problem is that the questions concerning cell phone use were not well thought out. It seems that epidemiologists did not care at all about details of exposure to cell phone radiation. They just wanted to know it - "roughly".

In the first cohort, called 'Danish Cohort', the information on exposure of persons to cell phone radiation is completely useless for the purpose of determining whether causality exists between radiation exposure and cancer (for details see letters to the British Medical Journal and The Scientist Magazine story).

In the spring of 2013, the results from the second cohort were published and called The Million Women Study. As seen from the description of the study, its primary goal was to examine the effects of hormone replacement therapy in women over 50 years of age.

This, by design, indicates that the results of this study apply only to a certain sex (females) and age (over 50) group and can not be freely extrapolated to the cell phone users as a whole. Furthermore, period of the exposure to cell phone radiation examined in The Million Women Study is far too short to be relevant when examining causality link between cell phone radiation and cancer.

The information about cell phone radiation exposures obtained for the study was as follows (quote from the study): "Women in the study have been asked twice about mobile phone use. In a survey conducted between 1999 and 2005 (to which about 65% of women recruited in 1996–2001 replied [sic!]), women were asked: 'About how often do you use a mobile phone?', and given three options to respond: 'never', 'less than once a day', 'every day'; and 'For how long have you used one?' (participants were asked to provide total years of use)."

The authors did not obtain information about cell phone usage per day or week. Cell phone users talking on the phone for few minutes or for few hours per week were analyzed together. When considering the latency of brain cancer, the follow-up period was far too short to provide relevant and reliable information. This extremely limited information about the exposures to cell phone radiation is absolutely inadequate to determine whether exposures have, or have not, causal link with cancer.

The inadequacy of the collected the information on the exposure is very disturbing. It is like scientists evaluating the health risk in smokers and not asking how many cigarettes per day someone smokes.

The Million Women Study has shoddy exposure design leading to shoddy results and ending with shoddy conclusions.

The Million Women Study is, similarly with the Danish Cohort, yet another example of the complete failure of epidemiologists to design scientifically relevant study on cell phone radiation and brain cancer.

It is embarrassing to hear that some scientists consider the “epidemiological failure”, called The Million Women Study, as a “well designed” research.

Forbes' Magazine blogger, Geoffrey Kabat of the Albert Einstein College of Medicine in New York City, in his recent post says about The Million Women Study: “The strengths of this design are two-fold. First, it follows the actual temporal sequence, with exposure preceding disease. Second, since information on exposure is obtained before the onset of illness, this information cannot be biased (distorted) by the presence of illness.”

Indeed, these could be the strengths of the study if the information on exposures was relevant.

Mr. Kabat writes also that: “Because of its large size and prospective design, the Million Women Study results represent an important contribution.”

Big is not always beautiful, especially when one side of the examined equation, the radiation exposure data, are shoddy.

I asked also opinions from the few prominent scientists about The Million Women Study. Here are their opinions, directly as provided via e-mails:

Michael Repacholi, retired Head of the WHO EMF Project, agrees with Geoffrey Kabat that the Million Women Study is a valuable proof of no cancer risk:

“This is a very large, well-conducted cohort study showing no increased incidence of glioma or meningioma with mobile phone use of 10 or more years. However, the study reported a trend of increasing risk of acoustic neuroma. When the results were combined with the Danish cohort study, that had a much larger number of these tumours, no statistical increase was found with mobile phone use of 10 or more years. Aside from the obvious difficulties in accurately assessing people's exposure to mobile phones, the evidence from well-conducted epidemiological and animal studies is now establishing that mobile phone use does not cause or increase the incidence of head or neck cancers.”

The above opinion of Michael Repacholi should be also viewed in the context of his recent criticism of epidemiology. His opinion was that epidemiology is unable to provide reliable information on causality link between cell phone radiation and brain cancer. As Mr. Repacholi said in his Guest Blog on BRHP: “my concern is that there is an over-reliance on epidemiology studies.”

However, epidemiologists were cautious and did not consider the evidence provided by The Million Women Study to be as great as Kabat and Repacholi thought.

Michael Kundi of the Medical University of Vienna, Austria, considers it a very good idea to use the existing large cohorts to study cell phone radiation and cancer issue. However, he points out that the authors of the Million Women Study did not do a good job:

“It is definitely worthwhile to try and use a large cohort of people that are available for investigations like the cohort of the Million Women Study. This cohort has been used for many important health issues and will continue to be used for a variety of research questions. Having said this, I regret to say that the authors have not put much thought into the issue of mobile phone use and brain tumors. It is almost impossible to study induction of brain tumors because of the short observation period. That is, most if not all of the tumors diagnosed during the follow-up must have already existed at the time of commencing use of a mobile. This leaves us with studying effects on tumor growth rate and/or progression. In the case of glioma the peculiarities of the relationship of incidences with age have to be considered. In this

cohort there are only women and they are in a narrow age range of about 60 years. The consequence of this fact is that if mobile phone use leads to an increased growth rate of the tumor and therefore an earlier diagnosis the risk estimate must be low or even less than one (because at older age the incidence is declining). The situation for acoustic neuroma is different because the age-incidence function differs from that of glioma.”

Bruce Armstrong of the Sydney University, Australia, considers that The Million Women Study is insufficient to think of down-grading the IARC classification of cell phone radiation from the current possible carcinogen category to lower one:

“A total of 1,261 primary intracranial neoplasms were diagnosed during follow-up, which is sufficient to make a potentially worthwhile contribution to literature on mobile phone use and brain tumours. Some 50,000 invasive neoplasms at other sites were also diagnosed, which can also contribute to knowledge about the relationship between other cancers and mobile phone use. Of the intracranial tumours investigated (glioma, meningioma, pituitary tumours and acoustic neuroma) only risk of acoustic neuroma was increased in women who were longer term users of a mobile phone. This result is coherent with results from the most recent case-control studies of mobile phone use and acoustic neuroma but not with the absence of increase in risk of acoustic neuroma reported from the Danish cohort study of mobile phone subscribers. While this study adds to the evidence on the relationship between mobile phone use and intracranial tumours, it does not add sufficiently, in my opinion, to shift in either direction the IARC’s conclusion that there is limited evidence in humans for carcinogenicity of radiofrequency radiation.”

Joel Moskowitz of the University of California at Berkeley has also serious doubts about the design and quality of the outcome of The Million Women Study:

“With regard to investigating the association between cell phone use and subsequent tumor risk (which was not the primary purpose of the “million women” study), this study had several major shortcomings which would undermine its ability to find this association. First, cell phone use was measured only at the beginning of the study, and it was assessed too crudely to expect to find an association with tumor risk. When women enrolled in the study, they were asked how many years they used a cell phone, and if they did, whether they used it daily or less than daily. The researchers had no follow up assessments to determine whether the women continued to use their cell phones over time so they had to assume that cell phone users continued to use their cell phones. More importantly, the researchers could not assess how much time the women spent on a cell phone either before or during the course of the study so women who used a few minutes almost every day at baseline would be lumped together with women who used their phone a half hour or more per day. Second, the study failed to assess cordless phone use which likely exceeded cell phone use among these women due to the high cost of cell phone minutes during this period. Cordless phone use has been found in other research to increase brain tumor risk. Third, brain tumors can take several decades to develop and few women in this study had used their cell phones for ten or more years. Fourth, about 40% of the 1.3 million women who participated in the study were excluded from the cell phone analyses—most because they failed to provide any cell phone information. This large loss of research participants limits how generalizable the study findings are and could have biased the results. Despite these major shortcomings, the study reported a statistically significant doubling of risk of acoustic neuroma, a tumor on the nerve from the ear to the brain, among those who used cell phones for 10 or more years. Moreover, this association was related to the number of years of cell phone use.”

Mark Elwood, of the University of Auckland in New Zealand is not convinced that the provided evidence is sufficiently reliable to convince the scientists and the general public alike:

"These scientists took the opportunity of asking a few questions about cell phone use in the huge British 'Million Women' study, where women attending breast cancer screening clinics were invited. Over the next 10 or more years, women (average age 59) who reported the most use of cellphones had the same risk of developing brain cancers than women who did not use cellphones at the time that was asked (and also, the same risk of all cancers, and of 18 major types of cancer). So, another of many studies showing no risk from using cellphones, but like all other studies, it can't prove that there's no risk. In the many analyses, there was an increased risk of one rather rare tumor, based on only 8 cases; but that was acoustic neuroma, a tumor of the nerve to the ear, and therefore in the high exposure zone from cellphones. And the study doesn't cover men, younger people, or risks beyond about 10 years. So the debate will continue."

Elisabeth Cardis, of CREAL-Centre for Research in Environmental Epidemiology in Spain and formerly Principal Investigator of the Interphone Project, is cautious and considers results of The Million Women Study as too weak:

"Am a bit surprised at the lack of mention of the acoustic neuroma results in the conclusion - particularly since this and glioma are the two tumour types for which there is currently the most evidence from other studies (including Interphone and the Japanese study). It seems that the first questionnaire about mobile phone use was asked over a long time period 1999-2005 but the follow-up is correctly calculated from the time the questionnaire was asked. Of the 1261 intracranial CNS tumours, 754 occurred among those who reported ever use at first questionnaire.

Only 90 of these, however, were among women who reported using the phone every day and 100 among those who reported 10+ years of use. Numbers get even smaller when the first 3 years of follow-up are excluded - 91 with 10+ years. It would be nice to see results by some form of amount of use, but obviously the information collected is very limited - ever use, daily use and number of years - but perhaps looking at categories of daily use in different periods of time since start ... but the numbers would get very small."

From the above comments of prominent epidemiologists the general conclusion can be drawn that despite the size of The Million Women cohort, the numbers of tumors are small and the information about the cell phone use is nonexistent. Therefore, it is not possible to draw any scientifically reliable conclusions based on the results of The Million Women Study.

Setting up large cohort for epidemiological study is expensive and laborious. That is why it is indeed a very good idea to use the already existing cohorts to examine causality link between cell phone radiation exposures and brain cancer.

However, the radiation exposure information, both the length and the strength/intensity of exposure, must be properly collected. Scientists working on the Danish Cohort and The Million Women Study, failed in the study design. Radiation exposure information collected in both cohorts is shoddy.

It is very disappointing that yet again epidemiologists failed. They used funds to provide us with shoddy studies. What is very worrying is the fact that these studies were published in peer-review journals and are now considered, by some, as "reliable scientific evidence".

It is simply an embarrassing show of scientific incompetence.

<http://communities.washingtontimes.com/neighborhood/between-rock-and-hard-place/2013/oct/3/million-women-study-another-bad-study-cell-phones-/>

Cell Phone Radiation Damages Sperm

Scientists from the Environmental Working Group publish a review of 10 studies that found cell phone radiation damages sperm.

Joel M. Moskowitz, PRLog (Press Release), Jun 28, 2012

Today the Environmental Working Group (EWG) published a review of ten studies that found cell phone radiation damages human sperm.*

"EWG scientists have analyzed 10 scientific studies documenting evidence that cell phone radiation exposure leads to slower, fewer and shorter-lived sperm. The studies raise concerns for men who carry their phones on their belts or in pants pockets."

The EWG asked me to serve as an external reviewer because I disseminated a review paper on this topic published online by the *Journal of Andrology* last July. This paper was recently published in the print version of the Journal.** Although, only two media sources in the U.S. covered this paper last summer, Men's Health and CNET, the CNET article was reprinted on more than 100 news web sites in six other countries.

Unfortunately for public health in the U.S., our news media have been reluctant to report on health risks associated with cell phone use as compared to other countries. I hope our news media do a better job in covering the sperm damage issue now because infertility is a common problem here. Moreover, men just need to take simple precautions to reduce potential harm from cell phone use.

As the EWG notes, there is preliminary evidence of reproductive health effects in children associated with fetal exposure to cell phone radiation so pregnant women as well as teens should take precaution. At a minimum, all should heed the advice buried "in fine print" in one online cell phone user manual ...

"use hands-free operation if it is available and keep the BlackBerry device at least 0.98 in. (25mm) from your body (including the abdomen of pregnant women and the lower abdomen of teenagers) when the BlackBerry device is turned on and connected to the wireless network."
<http://swampland.time.com/2010/10/15/blackberry-keep-our-...>

* Environmental Working Group. Cell Phone Radiation Damages Sperm, Studies Show. Jun 28, 2012; URL: http://www.ewg.org/cellphoneradiation/sperm_damage.

** La Vignera et al. Effects of the exposure to mobile phones on male reproduction: a review of the literature. *Journal of Andrology*. 2012 May/June: 33(3):350-356. URL: <http://www.andrologyjournal.org/cgi/content/full/33/3/350>.

ABSTRACT: The use of mobile phones is now widespread. A great debate exists about the possible damage that the radiofrequency electromagnetic radiation (RF-EMR) emitted by mobile phones exerts on different organs and apparatuses. The aim of this article was to review the existing literature exploring the effects of RF-EMR on the male reproductive function in experimental animals and humans. Studies have been conducted in rats, mice, and rabbits using a similar design based upon mobile phone RF exposure for variable lengths of time. Together, the results of these studies have shown that RF-EMR decreases sperm count and motility and increases oxidative stress. In humans, 2 different experimental approaches have been followed: one has explored the effects of RF-EMR directly on spermatozoa and the other has evaluated the sperm parameters in men using or not using mobile phones. The results

showed that human spermatozoa exposed to RF-EMR have decreased motility, morphometric abnormalities, and increased oxidative stress, whereas men using mobile phones have decreased sperm concentration, decreased motility (particularly rapid progressive motility), normal morphology, and decreased viability. These abnormalities seem to be directly related to the duration of mobile phone use.

Additional Resources

Environmental Health Trust web site:

<http://environmentalhealthtrust.org/men/>

Report: Cell phone use could reduce sperm count

Dong Ngo, CNET, August 18, 2011

http://www.cnet.com/8301-17918_1-20093675-85/report-cell-phone-use-could-reduce-sperm-count/

<http://www.prlog.org/11911996-cell-phone-radiation-damages-sperm.html>

Cell phones may damage sperm, health advocacy group says

Laurie Tarkan, Fox News.com, July 5, 2012

Men who carry their cell phone or Blackberry on their belt loop or in their pocket may be posing a risk to the health of their sperm and their fertility.

A major health advocacy group released a new report on the potentially harmful effects of cell phones on sperm. The Environmental Working Group (EWG) reviewed the scientific literature and reported that 10 studies have found significant changes in sperm exposed to cell phone radiation.

The study reported: In the most striking findings, men who carried their phones in a pocket or on the belt were more likely to have lower sperm counts and/or more inactive or less mobile sperm.

People are so preoccupied with brain tumors that the fertility issue gets very little play, said Louis Slesin, editor of *Microwave News*, a newsletter on electromagnetic radiation.

Exposure to cell phone radiation has also been associated with markers for sperm damage, such as higher levels of reactive oxygen species (chemically reactive molecules containing oxygen), oxidative stress, DNA damage and changes in sperm morphology.

We have enough evidence to issue precautionary health warnings, said Dr. Joel Moskowitz, director of the Center for Family and Community Health in the School of Public Health at the University of California at Berkeley. The evidence for sperm damage is quite consistent across many studies, he added.

The issue is far from settled, yet the proposals put forward by EWG are low-cost precautionary actions, Slesin said.

Another [review article](#) published last year in the *Journal of Andrology* examined the scientific literature on both animals and humans. Those authors came to similar conclusions as the EWG report. But they also cautioned that more studies are necessary to provide stronger evidence that cellular phone use disturbs sperm and testicular function because the existing literature has several limitations.

The EWG highlighted several results from the existing studies:

Men who carried a phone in a hip pocket or on the belt had 11 percent fewer mobile sperm than men who kept a phone elsewhere on the body.

Men who carried a cell phone on the belt and used it intensively during a five-day test period had a 19 percent drop in highly motile sperm from their previous levels.

Men who talked on the phone for more than an hour a day had 17 percent fewer highly motile sperm than men who talked less than 15 minutes a day.

Using a Bluetooth device or other headset may actually make things worse because you're likely to keep your device on your belt or in your pocket while using the phone. This means that although the head is not exposed to radiation when the phone is in use, the sperm are being constantly exposed. According to the EWG report, several studies have found lower sperm count and poorer sperm quality in men who use Bluetooth devices or headsets compared to men who put their phones to their ears.

Men just need to take simple precautions to reduce potential harm from cell phone use, Moskowitz

said. According to EWG:

Men can carry their cell phones in their pockets if they keep them turned off, and turn the phone on periodically to check for messages.

Men should always remove their cell phone from their pockets when making a call using a Bluetooth or headset as most electromagnetic radiation is emitted from the phone when talking on the phone.

Check this list for the cell phones that emit the highest radiation.

Laurie Tarkan is an award-winning health journalist whose work appears in the New York Times, among other national magazines and websites. She has authored several health books, including "Perfect Hormone Balance for Fertility." Follow her on Twitter and Facebook.

<http://www.foxnews.com/health/2012/07/05/cell-phones-may-damage-sperm-health-advocacy-group-says/>

Cell Phone Radiation, Pregnancy, and Sperm

The latest, peer-reviewed science finds that prenatal cellphone radiation exposure damages test mammals' brains and offspring, and cellphone radiation exposure damages sperm in humans.

Joel M. Moskowitz, PRLog (Press Release), Nov 19, 2012

What you don't know, what you need to find out, and what you can do now

National Press Club, Washington, DC, November 12, 2012

Several new, independent studies confirm previous research that pulsed digital signals from cell phones disrupt DNA, impair brain function and damage sperm.

Because fetuses, children and teens are particularly vulnerable, the American Academy of Pediatrics sent a letter to the Federal Communications Commission (FCC) asking for a review of cell phone exposure limits.

Also, the U.S. Government Accountability Office (GAO) issued a report this summer calling on the FCC to update cell phone exposure limits and testing requirements. The report noted that the testing requirements are inadequate as the phones are used closer to the head and body than the test requires. Thus, users' exposure to cell phone radiation may exceed the legal limit.

Six experts summarized the research at the National Press Club:

- Hugh Taylor, MD, PhD, Chairman of Obstetrics and Gynecology, Yale Medical School;
- Ronald B. Herberman, MD, TNI Bio Tech Inc, president of American Association of Cancer Institutes;
- Devra Davis, PhD, President Environmental Health Trust;
- Nesrin Seyhan, PhD, Chairman, Department of Biophysics, Gazi University;
- Suleyman Kaplan, MD, Professor, Embryology, Ondokuz Mayıs University; and
- Igor Belyaev, PhD, Deputy Director, National Cancer Institute of Slovakia and Russian Academy of Sciences.

The conference was sponsored by the Environmental Health Trust, Ondokuz Mayıs University and Gazi University in Turkey, and the National Cancer Institute of Slovakia.

The slides used in these presentations and additional resources are available from the Collaborative on Health and the Environment at: http://www.healthandenvironment.org/partnership_calls/11452?res.

GAO Report: <http://www.gao.gov/products/GAO-12-771>

Environmental Health Trust: <http://ehtrust.org/>

Environmental Working Group review of sperm damage research: <http://www.prlog.org/11911996>

Dr. Dariusz Leszczynski's science blog on mobile phone radiation and health: <http://betweenrockandhardplace.wordpress.com/>

Video of press conference (1 hour, 58 minutes): <http://www.youtube.com/watch?v=tnn6gNyRU7g>

<http://www.prlog.org/12026867-cell-phone-radiation-pregnancy-and-sperm.html>

Big Week for Cell Phone Radiation Legislation

A "cell phone right to know" bill was just introduced in the Congress, and the City and County of San Francisco will defend its "cell phone right to know" ordinance against a CTIA lawsuit in a federal appeals court.

Joel M. Moskowitz, PRLog (Press Release), Aug 6, 2012

A "cell phone right to know" bill was just introduced in the Congress, and on Thursday, the City and County of San Francisco will defend its "cell phone right to know" ordinance against a CTIA lawsuit in the 9th District Court of Appeals.*

Although the text for the newly proposed federal legislation is not yet available from the Library of Congress,** a press release appears below. I plan to analyze the bill when the text becomes available.

Two years ago, I published an op-ed in the San Francisco Chronicle about cell phones that called for community health education, government-funded research independent of industry to avoid conflicts of interest, and more protective regulatory standards and warning labels. See below for a link to my op-ed and additional concerns I have raised more recently.

The federal legislation appears to address a major concern I raised on June 15 (link below). Namely, that an FCC review of the current inadequate cell phone radiation standards would rubber stamp the 16-year old standards. The proposed legislation would require a different agency with the appropriate expertise to conduct the review—the Environmental Protection Agency.

The only major cell phone radiation health effects research our federal government currently funds is a study of the effects of 2G (GSM and CDMA) on mice and rats by the National Toxicology Program. The preliminary results from this study should be available by 2014. However, 2G technology will likely be obsolete in the US by the end of 2016.*** To date, little research has been conducted on the health effects of 3G, and some research suggests that this carrier technology damages DNA at much lower exposure levels than 2G. No research that I am aware of has been conducted on 4G.

* Thursday, Aug 9, 9:00 a.m. Courtroom 1, 3rd Floor; 11-17707; 11-17773) CTIA - The Wireless Assoc. v. City & County of SF Federal N. Cal.;
<http://www.ca9.uscourts.gov/datastore/calendaring/2012/07...>

** Bill Summary & Status; 112th Congress (2011 - 2012); H.R.6358; <http://thomas.loc.gov/cgi-bin/bdquery/z?d112:h.r.6358>:

*** "AT&T to Shutter 2G Network by Jan. 1, 2017";
<http://www.pcmag.com/article2/0,2817,2408067,00.asp>

<http://prlog.org/11943091>

San Francisco's Cell Phone Fact Sheet is Factual

Contrary to the recent opinion issued by the 9th U.S. Circuit Court of Appeals, the revised fact sheet adopted by San Francisco to implement its cell phone "right to know" ordinance is "factual and uncontroversial."

Joel M. Moskowitz, PRLog (Press Release), Sep 12, 2012

Contrary to the recent, unpublished opinion issued by the 9th U.S. Circuit Court of Appeals, the revised fact sheet adopted by San Francisco to implement its cell phone "right to know" ordinance is "factual and uncontroversial." (1)

This ordinance is the first in the U.S to require cell phone retailers to distribute a fact sheet that informs customers that cell phone use may increase their risk of cancer. Furthermore, it provides important information about how to use cell phones safely to reduce potential health risks.

All but one of the assertions in the fact sheet appear on the FCC and FDA web sites. (2) A statement about children's greater exposure to cell phone radiation has been documented in the peer-reviewed, scientific literature by Professor Om Gandhi and his colleagues. (3)

The FCC and FDA make similar recommendations on their web sites for consumers who are concerned about their exposure to cell phone radiation so the San Francisco fact sheet is no more controversial than the Federal government's advice to consumers who wish to reduce potential health risks.

San Francisco's revised fact sheet incorporates the concerns raised by the CTIA, the wireless industry lobbying group, about the original fact sheet developed by the City. The revised fact sheet was approved by U.S. District Judge William Alsup who heard the lawsuit filed by the CTIA against San Francisco. According to the judge, the CTIA chose not to contest the revised fact sheet but now claims it did not have the opportunity to do so.

Although most manufacturers issue safety warnings, the information is often buried in user manuals and poorly written. In contrast, the Blackberry Torch provides exemplary recommendations that are similar to those found in the San Francisco fact sheet. (4)

Since the original hearing on this case, the U.S. Government Accountability Office issued a report that challenges the FCC's certification of cell phone safety and called on the FCC to revamp its cell phone testing procedures because cell phone users generally keep their phones closer to their body than the test allows. Thus, cell phone users may be exposed to more radiation than the FCC considers to be safe. (5) Also, a bill was introduced in the Congress that would require cell phone warning labels and make the Environmental Protection Agency the lead Federal agency for protecting the public from cell phone radiation health risks. (6)

For more information about the San Francisco cell phone "right to know" ordinance see <http://www.prlog.org/11879000>.

The revised fact sheet and an annotated version of the fact sheet that includes citations from the FCC and FDA web sites is available upon request. (7)

References

(1) Egelko, B. Court blocks S.F. warning on cell phones. San Francisco Chronicle. Sep 10, 2012.

<http://www.sfgate.com/bayarea/article/Court-blocks-S-F-wa...>

(2) Supporting assertions for the fact sheet can be found at the following URL's on the FCC and FDA web sites:

FCC

<http://www.fcc.gov/encyclopedia/faqs-wireless-phones>

<http://www.fcc.gov/guides/wireless-devices-and-health-concerns>

<http://transition.fcc.gov/oet/rfsafety/rf-faqs.html>

<http://transition.fcc.gov/oet/rfsafety/>

FDA

[http://www.fda.gov/Radiation-](http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116335.htm)

[EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116335.htm](http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116335.htm)

[http://www.fda.gov/Radiation-](http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116331.htm)

[EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116331.htm](http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116331.htm)

[http://www.fda.gov/Radiation-](http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116293.htm)

[EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116293.htm](http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/Cellphones/ucm116293.htm)

(3) "When electrical properties are considered, a child's head's absorption can be over two times greater, and absorption of the skull's bone marrow can be ten times greater than adults." (Gandhi, Morgan, de Salles, Han, Herberman, Davis. Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children. Electromagn Biol Med 2012; 31(1):34-51. <http://www.ncbi.nlm.nih.gov/pubmed/21999884>)

(4) See page 23 in

http://docs.blackberry.com/en/smartphone_users/deliverables/18620/BlackBerry_Torch_9800_Smartphone-Safety_and_Product_Information-T43156-696706-0806024453-001-US.pdf

(5) "Exposure and Testing Requirements for Mobile Phones Should Be Reassessed." GAO-12-771, Jul 24, 2012. <http://www.gao.gov/products/GAO-12-771>

(6) Tsukayama H. GAO criticizes FCC's standards for cellphone radiation. Washington Post, Aug 7, 2012. http://www.washingtonpost.com/business/economy/gao-criticizes-fccs-standards-for-cellphone-radiation/2012/08/07/08c1e91e-e0c9-11e1-8fc5-a7dcf1fc161d_story.html

(7) For a copy of the revised fact sheet and an annotated version of the fact sheet, email Dr. Joel Moskowitz at jmm@berkeley.edu.

<http://www.prlog.org/11973342>

San Francisco Updates Cell Phone Safety Warnings

San Francisco updated its cell phone safety recommendations following the settlement of a lawsuit that blocked implementation of the city's cell phone "right to know" law.

Joel M. Moskowitz, PRLog (Press Release), June 3, 2013

San Francisco updated its cell phone safety recommendations on the city's web site following the settlement of a lawsuit filed by the CTIA—The Wireless Association that blocked implementation of the cell phone "right to know" law adopted by the city in 2010.

After a three-year battle, the city decided to disband with its cell phone law rather than continue to fight the CTIA and risk having to pay the industry's legal fees. The case was settled "in exchange for a waiver of attorneys' fees" even though the city believes the "Ninth Circuit's opinion is deeply flawed." (1)

Meanwhile, the CTIA has been citing the Ninth Circuit's opinion around the country in an effort to deter state and local policy makers from adopting cell phone "right to know" laws.

However, the city's web site points out that because the court's decision is unpublished, it is only applies to San Francisco. Furthermore, the decision cannot serve as a precedent in any future litigation (1). Thus it is inappropriate for the industry to cite this case as a precedent for other jurisdictions.

The city reminds visitors to its web site that "the World Health Organization classified cell phone radiation as 'possibly carcinogenic to humans (Group 2B)' based on increased risk for glioma, a malignant type of brain cancer, associated with wireless phone use." (1)

In addition to increased risk for glioma, the World Health Organization included increased risk for acoustic neuroma, a tumor on the nerve from the ear to the brain, in its newly published monograph about cell phone radiation and cancer. (2)

San Francisco recommends on its web site the following strategies to reduce exposure to RF energy from cell phones. The goal is to increase the distance between your body and your cell phone whenever using and carrying the device. (3)

- **"Limit cell phone use by children:** Developing brains and thinner skulls lead to higher absorption in children.
- **Use a headset, speakerphone, or text instead:** Exposure decreases rapidly with increasing distance from phone.
- **Use a belt clip or keep your phone in a knapsack, briefcase, or handbag to keep some distance between your phone and body:** Do not carry your phone directly on your body or at least maintain the recommended safe distance specified in your phones' user manual.
- **Avoid using your cell phone in areas with a weak signal (in elevators, on transit, or when indicated by your phone):** Using a cell phone in areas of good reception decreases exposure by allowing the phone to transmit at reduced power.
- **Reduce the number and length of calls.**
- **Turn off your cell phone when not in use."** (3)

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(1) SF Environment. Using Cell Phones Safely. URL: <http://www.sfenvironment.org/article/safer-practices/using-cell-phones-safely>.

(2) Non-ionizing radiation, Part II: Radiofrequency electromagnetic fields / IARC Working Group on the Evaluation of Carcinogenic Risks to Humans (2011: Lyon, France). Vol. 102 (2013). URL: <http://monographs.iarc.fr/ENG/Monographs/vol102/index.php>.

(3) SF Environment. How can I reduce my exposure to radiofrequency-energy from cell phones? URL: <http://www.sfenvironment.org/solution/how-can-i-reduce-my-exposure-to-radiofrequency-energy-from-cell-phones>.

<http://www.prlog.org/12149797>

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(2) Non-ionizing radiation, Part II: Radiofrequency electromagnetic fields / IARC Working Group on the Evaluation of Carcinogenic Risks to Humans (2011: Lyon, France). Vol. 102 (2013). URL: <http://monographs.iarc.fr/ENG/Monographs/vol102/index.php>.

(3) SF Environment. How can I reduce my exposure to radiofrequency-energy from cell phones? URL: <http://www.sfenvironment.org/solution/how-can-i-reduce-my-exposure-to-radiofrequency-energy-from-cell-phones>.

<http://www.prlog.org/12149797>

Florida City Adopts Cell Phone Precautionary Health Warnings

Pembroke Pines in Florida joined a handful of cities when it adopted a resolution on November 20 that warns the public about the health effects of cell phone radiation and precautionary safety measures.

Joel M. Moskowitz, PRLog (Press Release), Nov 27, 2012

The Pembroke Pines cell phone radiation resolution expresses the city's "urgent concerns arising from recent medical science reports which advise of the possible and adverse health effects delivered upon those who use cell phones, including, but not limited to, cancer, as a result of the non-ionized radiation emitted by cell phones."

The city's resolution was adopted a month after Jimmy Gonzalez, an attorney and resident of the city, made a presentation to the City Commission about cell phone safety. He also discussed his own battle with cell phone induced cancer. After ten years of heavy cell phone use, Mr. Gonzalez was diagnosed with glioma, a serious and often fatal form of brain cancer on the side of his head where he used his phone. Moreover, he had a tumor in his chest near the breast pocket where he kept his cell phone, and a tumor on the hand which he used to hold his phone during calls.

The City's resolution (1) contains the following five provisions:

"expresses the City Commission's concern for the amount of radiation that cell phones are emitting into users' bodies in light of the scientific debate that cell phone radiation exposure causes cancer;

"strongly urges everyone to carefully read through their cell phone user manuals and user guides and follow all instructions therein as to how to reduce the amount of radiation that will be emitted into their bodies;

"encourages everyone to take all practical steps to keep themselves and their children well informed on the latest and ongoing scientific reports about the possible effects of cell phone radiation;

"resolves that additional scientific and medical research must be conducted by the public health community about the possible effects of cell phones' radiation upon adults, teenagers, and community about the possible effects of cell phones' radiation upon adults, teenagers, and children; and

"encourages that all local, state, and federal government agencies sworn to defend the public's health & safety take all reasonable steps to vigilantly monitor and report publicly the information disclosed by ongoing scientific and medical research about the possible effects of cell phones' radiation upon adults, teenagers, and children."

The resolution directs the city clerk to forward a copy to the League of Cities and County Board of Commissioners and to each municipality within Broward County.

Twelve nations and the European Union have adopted precautionary health warnings, but progress in the U.S. has been slow due to strong industry opposition.

Although the CTIA-The Wireless Association, based on its First Amendment rights, has challenged in court San Francisco's legislation that requires cell phone stores to distribute a court-approved fact sheet (2-4), no legal obstacles prevent communities from adopting legislation to warn citizens about cell phone radiation using public spaces such as public web sites, buildings, parks or streets.

The CTIA has blocked all state-level legislative efforts to date as well as many community-level efforts (5). The organization even refused to support a California bill that would simply remind people to read the warnings in their user manuals. The CTIA has stated in court and in public hearings that people might panic if they learned about the evidence for increased health risks associated with cell phone use. Although the CTIA attends 500 meetings per year with the Federal Communications Commission (FCC), the agency that regulates cell phone radiation, a CTIA vice president has argued that the organization merely educates policy makers and does not engage in lobbying. Another vice president has stated in a public hearing that the CTIA has never claimed that cell phones do not cause harm.

This summer the U.S. Government Accountability Office called for a review of the FCC's outdated cell phone radiation regulations adopted in 1996. A bill pending in Congress would require the U.S. Environmental Protection Agency to establish evidence-based standards that would replace the industry-set standards the FCC currently enforces.

(1) Pembroke Pines Resolution:

<http://ppines.legistar.com/ViewReport.ashx?M=R&N=Text&GID=38&ID=1288155&GUID=6A101DD1-3817-470E-9479-BF7E1D966654&Title=Legislation+Text>

(2) "Cell phone radiation warning on San Francisco government web site":

<http://www.prlog.org/11879000>

(3) "San Franciscos Cell Phone Fact Sheet is Factual": <http://www.prlog.org/11973342>

(4) "Big Week for Cell Phone Radiation Legislation": <http://www.prlog.org/11943091>

(5) "Cities and states consider cell phone radiation laws" (Kent German, c|net, August 17, 2011):

http://www.cnet.com/8301-17918_1-20058696-85/cities-and-states-consider-cell-phone-radiation-laws/#ixzz2DSPqdgU5

OTHER RESOURCES:

Presentation by Attorney Jimmy Gonzalez at the Pembroke Pines Commission Meeting, Oct 17, 2012:

Pre-2: Pembroke Pines resident Attorney Jimmy Gonzalez gave a presentation about cell phone safety, and described a cell phone use correlation to cancer and to his personal battle with brain cancer. The Commission asked for more information so that they can learn more about this issue.

AGENDA: <http://ppines.legistar.com/LegislationDetail.aspx?ID=1215152&GUID=520E1C3B-2FEF-40D5-9F29-54D27EB4CFED>

VIDEO presentation (see 3:05 - 11:50): <http://vp.telvue.com/player?chapter=35479&id=T01146>

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Cell phone radiation legislation adopted at the Pembroke Pines Commission Meeting (Item 10), Nov 20, 2012:

AGENDA: <http://ppines.legistar.com/View.ashx?M=A&ID=219325&GUID=022B6A21-FB7A-4B74-8CE0-C8BA4983EAA3>

VIDEO presentation (6:21): <http://www.facebook.com/photo.php?v=4082541416847>

RESOLUTION (No. 2012-R-41) text:

<http://ppines.legistar.com/ViewReport.ashx?M=R&N=Text&GID=38&ID=1288155&GUID=6A101DD1-3817-470E-9479-BF7E1D966654&Title=Legislation+Text>

<http://www.prlog.org/12031899-florida-city-adopts-cell-phone-precautionary-health-warnings.html>

Call for Action to Reduce Harm from Mobile Phone Radiation

The European Environment Agency published a major report today to alert governments about the need to attend to early warning signs about technology health risks, including mobile phones.

Joel M. Moskowitz, PRLog (Press Release), Jan. 23, 2013

The 750-page volume, "Late Lessons from Early Warnings," includes twenty new case studies and has major implications for policy, science and society. Although the report was prepared by the European Environment Agency to provide guidance to the EU nations, its implications are global. (1)

Brain tumor risk associated with cell phone use is addressed in one of the report's chapters. (2) The report highlights the classification of this form of electromagnetic radiation (EMR) as "possibly carcinogenic", or cancer causing, by the World Health Organization's (WHO) International Agency for Research on Cancer (IARC) in 2011.

The research that has found increased brain tumor risk associated with long term mobile phone use is reviewed. The authors note that governments and industry have been slow to respond to the WHO's precautionary warnings and urges policy makers to respond to early warnings more quickly. It argues that industries that cause future harm must pay for the damage and suggests that taking early precautions can stimulate rather than stifle innovation.

The report accuses the mobile phone industry of "inertia in considering the various studies and taking the IARC carcinogenic classification into account," criticizes the media for not "providing the public with robust and consistent information on potential health risks," and attacks governments for shirking "their responsibilities to protect public health from this widespread source of radiation."

Although the report acknowledges the many benefits of mobile phones to society, it recommends the need for precautionary actions to reduce cell phone radiation exposures to minimize the extent and seriousness of the risks to the brain and other organs.

The report makes four specific recommendations about cell phones:

- a. Governments, the mobile phone industry, and the public should take all reasonable measures to reduce EMR exposure, especially from mobile phones, particularly exposure to children and young adults who are likely most at risk for brain and salivary gland tumors. The report recommends texting, use of hands-free sets, and improved design of phones which generate less radiation and make hands-free use more convenient.
- b. Governments should reconsider the scientific basis for the present exposure standards "which have serious limitations such as reliance on the contested thermal effects paradigm; and simplistic assumptions about the complexities of radio frequency exposures."
- c. Mobile phones should be required to have effective labeling and warnings about potential risks for users.
- d. Adequate funding should be provided for the "urgently needed research into the health effects of phones" and base stations. Funding could include industry grants and a small fee on the purchase and/or use of mobile phones.

It is time for the U.S. to end its two decades of denial and assume a leadership role in adopting precautionary measures to reduce the potential harms associated with exposure to mobile phone radiation. Otherwise we may face a steep price in terms of preventable health care costs, lost productivity, and reduced quality of life. A nickel a month collected on each cell phone subscription would generate sufficient funds for the U.S. to undertake the needed training and research to head off this potential epidemic. (3)

For more information about the health risks of cell phone radiation and other forms of EMR see the new BioInitiative Report at <http://www.bioinitiative.org>. and my web site at <http://saferemr.com> .

(1) "The cost of ignoring the warning signs - EEA publishes 'Late Lessons from Early Warnings, volume II' "

New technologies have sometimes had very harmful effects, but in many cases the early warning signs have been suppressed or ignored. The second volume of Late Lessons from Early Warnings investigates specific cases where danger signals have gone unheeded, in some cases leading to deaths, illness and environmental destruction.

News Release, European Environment Agency, Jan 23, 2013. URL:
<http://www.eea.europa.eu/pressroom/newsreleases/the-cost-of-ignoring-the>

(2) Lennart Hardell, Michael Carlberg, and David Gee. "Mobile phone use and brain tumour risk: early warnings, early actions?" Chapter 21 in Part C-Emerging Issues. "Late lessons from early warnings: science, precaution, innovation." European Environment Agency. EEA Report No 1/2013. Pp. 541-561. January 23, 2013. URL:
Part C: <http://www.eea.europa.eu/publications/late-lessons-2/part-c-emerging-issues-1>

The full 750 page report is available at <http://www.eea.europa.eu/publications/late-lessons-2>

(3) Joel M. Moskowitz. "Comments on the 2012 GAO Report: 'Exposure and Testing Requirements for Mobile Phones Should Be Reassessed.'" URL: <http://saferemr.blogspot.com>.

<http://www.prlog.org/12065677-call-for-action-to-reduce-harm-from-mobile-phone-radiation.html>

Belgium Adopts New Regulations to Promote Cell Phone Radiation Safety

Children's mobile phones are banned. The specific absorption rate (SAR) must be listed on every mobile phone at the point of sale and a warning provided to customers to choose a lower SAR phone, use it moderately, and wear an earpiece.

Joel M. Moskowitz, PRLog (Press Release), Oct 24, 2013.

According to the Federal Public Service, beginning in March, 2014, new regulations will apply to the sale of mobile phones in Belgium. Children's mobile phones will be banned. The specific absorption rate (SAR) for every mobile phone must be listed at the point of sale and the following warning must be provided to customers:

"Think about your health – use your mobile phone moderately, make your calls wearing an earpiece and choose a set with a lower SAR value."

The Belgian government's additional recommendations include use of other hands-free methods to keep the phone away from the body such as text messaging, and not making calls when the signal is weak, such as in an elevator or in a moving vehicle.

All cell phones will be labeled with the letter A, B, C, D, or E, corresponding to the phone's specific absorption rating, or SAR, which is a measure of the maximum amount of energy deposited in an adult user's brain during a short phone call.

"A" indicates a SAR less than 0.4 watts/kilogram (w/kg), "B" from 0.4 to less than 0.8 w/kg, "C" from 0.8 to less than 1.2 w/kg, "D" from 1.2 to less than 1.6 w/kg, and "E" more than 1.6 w/kg.

Although phones sold in the U.S. cannot currently exceed 1.6 w/kg and are measured in a different manner than in Europe, the Federal Communications Commission (FCC) is considering weakening the U.S. standard and adopting the European or international standard which was developed by a private organization called ICNIRP. The multinational Telecom Industry has lobbied to weaken our protections in the interest of global "harmonization." This policy change is strongly opposed by numerous consumer groups, environmental groups, medical professionals and health scientists in the U.S. who have advocated for stronger regulations, not weaker ones, to protect public health.

In 2010, the city of San Francisco adopted a cell phone "right to know" law that is similar to the Belgian Government's new regulations, but after a lengthy legal battle in the Federal courts with the Telecom Industry, the city repealed the law earlier this year.

The new regulations by the Belgian government are in response to the International Agency for Research on Cancer's (IARC) declaration that radio frequency radiation is "possibly carcinogenic" based upon research that finds increased risk of brain cancer due to intensive use of a mobile phone.

Since the IARC declared that cell phone radiation is "possibly carcinogenic" in May, 2011, more evidence of brain cancer risk has been published in the peer-reviewed, scientific literature. The latest study by Lennart Hardell and colleagues in Sweden finds a three-fold increased risk of brain cancer after 25 years of cell phone and cordless phone use.

The American public needs to learn about the risks of using wireless devices and how to use them safely; otherwise, we may face a major public health crisis in the ensuing decades with the proliferation of these devices in our society.

The English translation of the Belgian government's press release along with supporting materials are available on my Electromagnetic Radiation Safety web site at:
<http://www.saferemr.com/2013/10/belgium-adopts-new-regulations-to.html> .

The supporting materials include sections covering frequently asked questions, general information about cell phone and other types of electromagnetic radiation, child leukemia, and electromagnetic hypersensitivity. Although some of the information is misleading in my opinion, it is worth examining.

<http://www.prlog.org/12231532>

**French Health Agency Recommends Children and Vulnerable Groups
Reduce Cell Phone Radiation Exposure**

In a major public announcement today, the French Agency for Food, Environmental and Occupational Health warned the public to reduce their exposure to cell phone radiation.

Joel M. Moskowitz, PRLog (Press Release), Oct 15, 2013

The French Agency for Food, Environmental and Occupational Health, ANSES, announced today the results of a two-year review by an expert Working Group of the scientific research on the risks related to exposure to radiofrequency (RF) radiation.

"This update has not brought to light any proven health effect and does not result in any proposed new maximum exposure limits for the population. However, limited levels of evidence do point to different biological effects in humans or animals. In addition, some publications suggest a possible increased risk of brain tumour, over the long term, for heavy users of mobile phones. Given this information, and against a background of rapid development of technologies and practices, ANSES recommends limiting the population's exposure to radiofrequencies – in particular from mobile phones – especially for children and intensive users, and controlling the overall exposure that results from relay antennas."

"The findings of this expert appraisal are therefore consistent with the classification of radiofrequencies proposed by the World Health Organization's International Agency for Research on Cancer (IARC) as "possibly carcinogenic" for heavy users of mobile phones.

In addition, the expert appraisal nevertheless shows, with limited levels of evidence, different biological effects in humans or animals, some of which had already been reported in 2009: these can affect sleep, male fertility or cognitive performance."

Due to the health concerns raised by the expert Working Group, ANSES made the following recommendations:

"Therefore, to limit exposure to radiofrequencies, especially in the most vulnerable population groups, the Agency recommends:

- for intensive adult mobile phone users (in talk mode): use of hands-free kits and more generally, for all users, favouring the purchase of phones with the lowest SAR values;
- reducing the exposure of children by encouraging only moderate use of mobile phones;
- continuing to improve characterisation of population exposure in outdoor and indoor environments through the use of measurement campaigns;
- that the development of new mobile phone network infrastructures be subject to prior studies concerning the characterisation of exposures, and an in-depth study be conducted of the consequences of possibly multiplying the number of relay antennas in order to reduce levels of environmental exposure;
- documenting the conditions pertaining at those existing installations causing the highest exposure of the public and investigating in what measure these exposures can be reduced by technical means.

- that all common devices emitting electromagnetic fields intended for use near the body (DECT telephones, tablet computers, baby monitors, etc.) display the maximum level of exposure generated (SAR, for example), as is already the case for mobile phones."

The Agency further recommends that children's exposure should be reduced "by encouraging only moderate use of mobile phones, ideally with hands-free kits and mobile terminals with the lowest SAR values."

The full press release and a link to the ANSES press kit is available on my SaferEMR web site at:
<http://www.saferemr.com/2013/10/french-health-agency-recommends.html>

<http://www.prlog.org/12226630>

India Adopts Health Warnings & U.S. Mobile Phone Standards

India adopts the U.S. cell phone radiation standard, issues health warnings and requires safety precautions in user manuals. Local and state governments in the U.S. should issue precautionary health warnings now to protect cell phone users.

Joel M. Moskowitz, PRLog (Press Release), Sep 4, 2012

India Adopts Health Warnings & U.S. Mobile Phone Standards

India just adopted the U.S. cell phone handset radiation standard. The Indian government also issued precautionary health warnings about cell phone use and is requiring manufacturers to include safety precautions in user manuals. (1)

Now more than 1.3 billion cell phone subscribers in seven countries will be covered by the U.S. cell phone radiation standard including the U.S., India, Canada, New Zealand, Bolivia, Taiwan, and South Korea. (2)

Moreover, thirteen nations and the European Union have issued precautionary health warnings about the need to limit exposure to cell phone radiation. The countries include Austria, Britain, Canada, Finland, France, Germany, India, Ireland, Israel, Italy, Russia, Sweden, and Switzerland.

Although the CTIA's (i.e., the wireless industry association) lawsuit over San Francisco's cell phone "right to know" law has not been resolved, the association has stated in public meetings and in courtrooms that it is fine if governments post precautionary health warnings about cell phone radiation on public property or on government web sites. Thus, local and state governments should take immediate action to protect consumers, especially children, from cell phone radiation by issuing health warnings in these public venues.

For more information about the San Francisco ordinance, see <http://www.prlog.org/11879000>.

References

(1) Government of India. Stringent Mobile Radiation Standards Come into Force from tomorrow. Aug 31, 2012. Press release appears below; see "Guidelines for Consumers."

(2) Wikipedia. List of countries by number of mobile phones in use.
[http://en.wikipedia.org/wiki/List_of_countries_by_number ...](http://en.wikipedia.org/wiki/List_of_countries_by_number_...)

Stringent Mobile Radiation Standards Come into Force from tomorrow

New Mobile Handsets to comply with SAR Value of 1.6W/KG Penalty, Random Checks Introduced for Enforcement

Press Information Bureau, Ministry of Communications & Information Technology, Government of India, Aug 31, 2012

Beginning tomorrow (1st September 2012) India will be among the select few countries in the world to

have stringent EMF (Electromagnetic Frequency) Radiation Standards, established in the interest of public health, for mobile towers and mobile handsets. Indian standards would now be 10 times more stringent than more than 90% countries in the world.

The following are the highlights of the Standards:

Mobile Towers (EMF Radiation Norms)

- * EMF (Electromagnetic Frequency) exposure limit (Base Station Emissions) has been lowered to 1/10th of the existing ICNIRP exposure level, effective 1st Sept. 2012.
- * Telecom Enforcement Resource & Monitoring (TERM) Cells have been entrusted with the job of conducting audit on the self certification furnished by the Service Providers. TERM Cell will carry out test audit of 10% of the BTS site on random basis and on all cases where there is a public complaint.
- * Telecom Engineering Centre (TEC) has revised the Test Procedure for measurement of EMF for verification of EMF compliance for BTS towers in accordance with new standards.
- * For non-compliance of EMF standards, a penalty of Rs. 5 lakhs is liable to be levied per BTS per Service Provider.
- * The BTS site details i.e. self certification, registration with TERM Cell, test results etc. is proposed to be provided on DoT web site for General Public information.

Mobile Handsets

- * All the new design of mobile handsets shall comply with the Specific Absorption Rate (SAR) values of 1.6 W/kg averaged over 1 gram of human tissue w.e.f. 1st Sept. 2012.
- * The mobile handsets with existing designs which are compliant with 2.0 W/kg averaged over 10 gram of human tissue, will continue to co-exist up to 31st August 2013. From 1st Sept. 2013, only the mobile handsets with revised SAR value of 1.6 W/kg would be permitted to be manufactured or imported in India.
- * SAR value information display on the mobile handsets like IMEI (International Mobile Equipment Identity) display. The information on SAR values to be made available to the consumer at the point of sale.
- * Mobile hand set manufactured and sold in India or imported from other countries shall be checked on random basis for compliance of SAR limit after TEC SAR Laboratory is set up by end of 2012. Test results from international accredited labs will be acceptable in the interim period.
- * The manufacturers in India will provide self declaration of SAR value of the handset.
- * Suitable amendments in the Indian Telegraph Rule under Indian Telegraph Act 1985 are being enacted in support of ensuring compliance of new SAR values for handsets.
- * Manufacturer's mobile handset booklet will contain safety precautions.
- * All cell phone handsets sold in the market in India will comply with relevant standards and shall be available in hand free mode.

SAR Test Laboratory:

* SAR Test Laboratory is being set up in Telecom Engineering Centre for testing of SAR value of mobile handsets imported/ manufactured in India.

New National SAR Standards from Telecom Engineering Centre

* National SAR standards from Telecom Engineering Centre are being finalized.

Measuring Instruments:

* DoT is procuring EMF radiation measuring instruments for TERM cell units.

* Outsourcing for EMF radiation measurement for BTS towers is also being considered.

Expert Group Study:

* A scientific study in India-specific context is being undertaken jointly by Dept. of Telecom and Dept. of Science & Technology in collaboration with ICMR, MOEF & Min of Science & Technology to derive norms based on credible scientific evidence taking into account diversity of Indian social context.

Guidelines to State Government

* Department of Telecommunication has released Guidelines covering BTS Towers so that some consistency gets evolved on setting up of BTS towers. Guidelines have been placed on DoT website.

Guidelines for Consumers

Guidelines for consumers on Mobile handset usage have been issued and hosted on DoT Web site (www.gov.dot.in) for general public awareness.

Some of them are:

1. Keep distance – Hold the cell phone away from body to the extent possible.
2. Use a headset (wired or Bluetooth) to keep the handset away from your head.
3. Do not press the phone handset against your head. Radio Frequency (RF) energy is inversely proportional to the square of the distance from the source -- being very close increases energy absorption much more.
4. Limit the length of mobile calls.
5. Use text as compared to voice wherever possible.
6. Put the cell phone on speaker mode.
7. When your phone is ON, don't carry it in chest/breast or pants pocket. When a mobile phone is ON, it automatically transmits at high power every one or two minutes to check (poll) the network.

Radiation Booklet

* A booklet addressing possible queries from mobile telecom users on radiation-related issues along with other informative inputs is also being placed on DoT website.

TEC Test Procedures Document for Service Providers and Term Cell Units

* TEC has revised the Test Procedure for measurement of EMF elaborating the methodology, calculations, measurements and report formats for verification of EMF compliance for BTS towers in accordance with new standards effective from 1st Sept. 2012. This will be applicable for all Mobile Service Providers and Term Cell Units to verify compliance.

Department of Telecommunications, Ministry of Communications & IT has ensured that the new EMF Radiation standards get implemented through close co-ordination with the industry.

The guidelines underline the Government's efforts at providing the best possible Telecom services across the country without compromising on public safety and human health. (Release ID :87152)

<http://www.prlog.org/11966704>

Russian Cell Phone Standards Offer Better Protection than American Standards

Unlike the U.S. radiofrequency standards that regulate cell phones, the Russian standards are based on the precautionary principle. Moreover, they are designed to protect the public from all risks due to cell phone radiation, not just from heating.

Joel M. Moskowitz, PRLog (Press Release), July 5, 2012

In a review paper just published online in the journal, *Bioelectromagnetics*, Michael Repacholi and his colleagues take issue with the “philosophy” underlying the Russian radiofrequency (RF) standards. Unlike the U.S. and European standards, the Russian standards are based on the precautionary principle and were designed to protect the public from all potential risks from exposure to cell phone radiation, not just heating effects.

The authors of this paper point out that the Russian RF standards were based on studies that demonstrated autoimmune effects of exposure to RF that were not necessarily pathological. In contrast to standards adopted by other governments including the U.S., Russia adopted a precautionary approach in setting the RF standards:

“The general approach to public health protection and setting exposure limits by previous Soviet and current Russian committees is that people should not have to compensate for any effects produced by RF exposure, even though they are not shown to be adverse to health (pathological). In other words, these committees assume there could be long-term health consequences if people have to compensate for RF exposures that produce biological but not pathological effects. Exposure limits are then set that do not cause any possible biological consequence among the population (regardless of age or gender) that could be detected by modern methods during the RF exposure period or long after it has finished. Their approach to protection is that limits of RF exposure should not cause even a temporary initiation of the protective or adaptive compensatory mechanisms over the near or long term. Thus, the final exposure limits are set as a fraction of the minimum RF exposure that is capable of provoking some adaptation-compensatory reactions in people.”

“This is an important difference from the approach used by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), which bases its limits on the lowest RF exposure that causes any established adverse health effect (RFLowest). Limit values in their guidelines are then set by assuming that there is maximum absorption of the RF field by people and then reducing the RFLowest by large safety factors to produce the final limits, normally by a factor of 50 lower than the RFLowest for the general public [ICNIRP, 1998].”

The authors claim that the Russian standards are based on old research that is flawed, but they do not critique this research as the focus of their paper is on the philosophy underlying the standards.

The authors do not discuss the serious limitations of the industry-developed (IEEE and ICNIRP) guidelines that form the basis for the U.S. and European standards. These standards only recognize adverse health effects caused by heating tissue (i.e., thermal effects) and not the various adverse health effects that research has shown to be associated with non-thermal mechanisms.

Unlike the U.S. standards adopted by the F.C.C. in 1996 which treat children like adults, the Russian guidelines for children are more sensible as they take a precautionary approach in protecting children's health:

“Children are not small adults since they are developing organisms with special sensitivities and might be expected to be more sensitive to EMF than adults [Grigoriev, 2005; Kheifets et al., 2005]. Thus, results of studies conducted on adults might not be validly extrapolated to children; therefore, the RNCNIRP [i.e., the Russian committee] considered that children need special consideration when developing exposure limits. According to the RNCNIRP, the following health hazards are likely to be faced in the near future by children who use mobile phones: disruption of memory, decline in attention, diminished learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to stress, and increased epileptic readiness. For these reasons, special recommendations on child safety from mobile phones have been incorporated into the current Russian mobile phone standard [Russian Standard, 2003].”

“Recommends limiting mobile phone call time as much as possible and limiting possibility of use by children age < 18 years, pregnant women and pacemaker wearers” (see 2003 Russian standards in Table 2)

The authors of this paper disparage Russia’s “philosophy of protection”:

“The philosophy of protection of the public- that RF exposure of individuals should not cause any compensatory response-is not used in standards outside of Russia. National authorities in most countries want to know what health effects they are protecting against and not make assumptions about what effects may occur. This is the philosophy of the ICNIRP and IEEE committees.”

If the purpose of a nation’s RF emission standards is to protect population health, doesn’t the precautionary approach seem more prudent? When the F.C.C. conducts the next review of its 16-year old RF standards for cell phone radiation, a precautionary perspective should be applied. The standards should be revised to enable cell phone communications with emissions that are “as low as reasonably achievable” (ALARA), and all non-thermal effects, including auto-immune and reproductive health effects, must be considered.

Source

Michael Repacholi, Yuri Grigoriev, Jochen Buschmann, Claudio Pioli. Scientific basis for the Soviet and Russian radiofrequency standards for the general public. Bioelectromagnetics. Published online July 2, 2012.

Abstract

The former Soviet Union (USSR) and the USA were the first countries to introduce standards limiting exposure to radiofrequency (RF) fields. However, the exposure limits in the USSR standards were always much lower than those in the USA and other countries. The objective of this article is to provide a history of the development of the Soviet and Russian RF standards. In addition, we summarize the scientific evidence used to develop the original USSR RF and subsequent Russian public health standards, as well as the mobile telecommunications standard published in 2003, but we do not critique them. We also describe the protective approaches used by the Soviet and Russian scientists for setting their limits. A translation of the papers of the key studies used to develop their standards is available in the online version of this publication.

URL: <http://onlinelibrary.wiley.com/doi/10.1002/bem.21742/abstract>

<http://www.prlog.org/11916029>

Italian Supreme Court Rules Cell Phones Can Cause Cancer

What are the implications of this ruling for the United States?

Joel M. Moskowitz, PRLog (Press Release), Oct 19, 2012

Contrary to the denials of many health agencies in the U.S. and in some other countries, the Italian Supreme Court has recognized a "causal" link between heavy mobile phone use and brain tumor risk in a worker's compensation case.

The Italian courts dismissed research co-financed by the mobile phone industry including the WHO Interphone study due to concerns about conflict of interest.

Instead, the courts relied on independent research conducted by Lennart Hardell and his colleagues in Sweden which showed consistent evidence of increased brain tumor risk associated with long term mobile phone use. Last year, the Hardell research was heavily relied upon by 31 experts convened by the WHO who classified radiofrequency energy, including cell phone radiation, as "possibly carcinogenic" in humans.

In our review of the cell phone use - tumor risk research published in the ***Journal of Clinical Oncology*** in 2009, we found that research co-financed by the Telecom industry was unlikely to report evidence of tumor risk and employed poorer quality research methods than independently-funded research. Moreover, in more recently published research, authors of studies co-financed by the industry dismissed as artifactual the evidence of increased brain tumor risk they found in children as well as adults.

In our paper, we raised concerns that conflicts of interest may have affected the conduct of the research and biased the reporting of it. In our rebuttal to three letters to the editor submitted by individuals with industry affiliations or funding, we called on governments to fund cell phone radiation research that is independent of industry in order to avoid even the appearance of a conflict of interest.

Since there are now more than 330 million cell phone subscribers in the U.S., an annual fee of 50 cents on each cell phone would generate sufficient resources to fund high quality, independent research that could promote safer technology development and fund a community education program about safer cell phone use.

Although 12 nations and the European Union have issued precautionary health warnings regarding mobile phone use, the U.S. has been in denial. The Telecom industry has blocked numerous attempts to pass cell phone warning legislation at the Federal, state, and city level. The industry even refused to support a bill in the California legislature by Senator Mark Leno that would simply remind consumers to read the safety information that is currently printed in their cell phone user manuals.

Only one city has been able to overcome intense lobbying by the Telecom industry. San Francisco adopted cell phone "right to know" legislation two years ago, but the Telecom industry (i.e., CTIA-The Wireless Association) blocked implementation of this law by filing a lawsuit claiming that the court-approved fact sheet violates the industry's First Amendment rights. The CTIA also moved its annual conference from San Francisco to punish the city.

The evidence of harm from cell phone radiation has been increasing so it is only a matter of time before lawsuits filed in U.S. courts by cell phone radiation victims will be successful. The Insurance industry will not provide product liability insurance due to concerns that juries will find that the Telecom industry has

behaved much like the Tobacco and Asbestos industries. So the Telecom industry could be faced with paying huge damages to individuals and governments.

The Telecom industry could become good corporate citizens, reduce potential product liability and protect consumers' health by allowing the FCC to adopt stronger regulations, by promoting precautionary safety warnings and by encouraging government to support independent research to promote safer wireless technologies.

Otherwise taxpayers may be forced to bail out yet another industry too big to fail.

For more information on the Italian Supreme Court ruling see:

<http://www.reuters.com/article/2012/10/19/italy-phones-id...>

<http://www.prlog.org/12004383-italian-supreme-court-rules-cell-phones-can-cause-cancer.html>

Smart Meters: Correcting the Gross Misinformation

La Maison du 21e siecle, Jul 11, 2012

Quebec-based magazine [La Maison du 21e siecle](#) asked physician [David O. Carpenter](#), former founding dean of the University at Albany (NY)'s School of Public Health, to comment on a letter published in the Montreal daily *Le Devoir* last May 24. This letter claimed wireless smart meters pose no risk to public health. Some forty international experts contributed to the following rebuttal.

We, the undersigned are a group of scientists and health professionals who together have coauthored hundreds of peer-reviewed studies on the health effects of electromagnetic fields (EMFs). We wish to correct some of the gross misinformation found in the [letter regarding wireless "smart" meters that was published in the Montreal daily Le Devoir on May 24](#). Submitted by a group [Quebec engineers, physicists and chemists](#), the letter in question reflects an obvious lack of understanding of the science behind the health impacts of the radiofrequency (RF)/microwave EMFs emitted by these meters.

The statement that « Thousands of studies, both epidemiological and experimental in humans, show no increase in cancer cases as a result of exposure to radio waves of low intensity... » is [false \(1\). In fact, only a few such studies — two dozen case-control studies of mobile phone use](#), certainly not thousands, have reported no elevations of cancer, and most were funded by the wireless industry. In addition, these reassuring studies contained significant experimental design flaws, mainly the fact that the populations followed were too small and were followed for a too short period of time.

Non industry-funded studies have clearly demonstrated a significant increase in cancer cases among individuals who have suffered from prolonged exposure to low-level microwaves, transmitted notably by radio antennas. The effects were best documented in meta-analyses that have been published and that include grouped results from several different studies: [these analyses](#) consistently showed an [increased risk of brain cancer](#) among regular users of a cell phone who have been exposed to microwaves [for at least ten years](#).

Brain Cancer Rates

Furthermore, the argument that brain cancer rates do not indicate an overall increase in incidence is not evidence that cell phones are safe: the latency for brain cancer in adults after environmental exposure can be long, up to 20-30 years. Most North Americans haven't used cell phones extensively for that long. The evidence of the link between long-term cell phone use and brain cancer comes primarily from Northern Europe, where cell phones have been commonly used since the 1990s.

Children are especially at risk. In May 2012, the [U.K.'s Office of National Statistics reported a 50 percent increase in incidence of frontal and temporal lobe tumors in children between 1999 and 2009](#). This statistic is especially disturbing since in May 2011, after reviewing the published scientific literature regarding cancers affecting cell phone users, [the International Agency for Research on Cancer \(IARC\) classified radiofrequency radiation as a 2B, possible human carcinogen](#). Despite the absence of scientific consensus, the evidence is sufficiently compelling for any cautious parent to want to reduce their loved one's exposure to RF/microwave emissions as much as possible, as recommended by [various countries](#) such as Austria, Belgium, [Germany](#), [Russia](#) and the [United Kingdom](#).

Electrosensitivity

Public fears about wireless smart meters are well-founded. They are backed by various medical authorities such as the Public Health Departments of [Santa Cruz County](#) (California) and of Salzburg

State (Austria). These authorities are worried about the growing number of citizens who say they have developed electrohypersensitivity (EHS), especially since for many of them, the symptoms developed after the installation of such meters (it takes some time for most people to link the two events).

Since the turn of the millennium, people are increasingly affected by ambient microwaves due to the growing popularity of wireless devices such as cell phones and Wi-Fi Internet. Therefore, the mass deployment of smart grids could expose large chunks of the general population to alarming risk scenarios without their consent. According to [seven surveys done in six European countries between 2002 and 2004, about 10% of Europeans have become electrosensitive, and experts fear that percentage could reach 50% by 2017](#). The most famous person to [publicly reveal her electrosensitivity is Gro Harlem Brundtland](#), formerly Prime Minister of Norway and retired Director of the World Health Organization (WHO).

[While there is no consensus on the origins and mechanisms of EHS](#), many [physicians and other specialists around the world](#) have become aware that EHS symptoms (neurological dermatological, acoustical, etc.) seem to be triggered by exposure to EMF levels well below current international exposure limits, which are established solely on short-term thermal effects (2). Organizations such as the [Austrian Medical Association](#) and the [American Academy of Environmental Medicine](#) have recognized that the ideal way to treat of EHS is to reduce EMF exposure.

Therefore, caution is warranted because the growing variety of RF/microwave emissions produced by many wireless devices such as smart meters have never been tested for their potential biological effects.

Well-known bioeffects

While the specific pathways to cancer are not fully understood, it is scientifically unacceptable to deny the weight of the evidence regarding the increase in cancer cases in humans that are exposed to high levels of RF/microwave radiation.

The statement that « there is no established mechanism by which a radio wave could induce an adverse effect on human tissue other than by heating » is incorrect, and reflects a lack of awareness and understanding of the scientific literature on the subject. In fact, [more than a thousand studies](#) done on low intensity, high frequency, non-ionizing radiation, going back at least fifty years, show that some biological mechanisms of effect do not involve heat. This radiation sends signals to living tissue that stimulate biochemical changes, which can generate various symptoms and may lead to diseases such as cancer.

Even though RF/microwaves don't have the energy to directly break chemical bonds, unlike ionizing radiation such as X-rays, there is scientific evidence that this energy can cause DNA damage indirectly leading to cancer by a combination of biological effects. [Recent publications](#) have documented the generation of free radicals, [increased permeability of the blood brain barrier](#) allowing potentially toxic chemicals to enter the brain, induction of genes, as well as altered electrical and metabolic activity in human brains upon application of cell phone RF/microwaves similar to those produced by smart meters.

These effects are cumulative and depend on many factors including RF/microwave levels, frequency, waveform, exposure time, biovariability between individuals and combination with other toxic agents. Clear evidence that these microwaves are indeed bioactive has been shown by the fact that low-intensity EMFs have proven clinically useful in some circumstances. Pulsed EMFs have long been used to successfully [treat bone fractures](#) that are resistant to other forms of therapy. More recently, frequency-specific, amplitude-modulated EMFs have been found useful to treat [advanced carcinoma](#) and chronic pain.

High frequency EMFs such as the microwaves used in cell phones, smart meters, Wi-Fi and cordless “DECT” phones, appear to be the most damaging when used commonly. Most of their biological effects, including symptoms of electrohypersensitivity, can be seen in the damage done to cellular membranes by the [loss of structurally-important calcium ions](#). Prolonged exposure to these high frequencies may eventually lead to cellular malfunction and death.

Furthermore, malfunction of the parathyroid gland, located in the neck just inches from where one holds a cell phone, may actually cause electrohypersensitivity in some people by reducing the background level of calcium ions in the blood. RF/microwave radiation is also known to [decrease the production of melatonin](#), which protects against cancer, and to [promote the growth of existing cancer cells](#).

Early warning scientists attacked

In recommending that the Precautionary Principle be applied in EMF matters, the European Environment Agency’s Director [Jacqueline McGlade wrote in 2009](#): “We have noted from previous health hazard histories such as that of lead in petrol, and methyl mercury, that ‘early warning’ scientists frequently suffer from discrimination, from loss of research funds, and from unduly personal attacks on their scientific integrity. It would be surprising if this is not already a feature of the present EMF controversy... » Such unfortunate consequences have indeed occurred.

The statement in the *Le Devoir* letter that « if we consider that a debate should take place, it should focus exclusively on the effects of cell phones on health » is basically an acknowledgement that there is at least some reason to be concerned about cell phones. However, while the immediate exposure from a cell phone is of much greater intensity than the exposure from smart meters, cell phone use is temporary.

Smart meters

Wireless smart meters typically produce atypical, relatively potent and very short pulsed RF/microwaves whose biological effects have never been fully tested. They emit these millisecond-long RF bursts on average 9,600 times a day with a maximum of 190,000 daily transmissions and a peak level emission two and a half times higher than the stated safety signal, as the California utility [Pacific Gas & Electric recognized](#) before that State’s Public Utilities Commission. Thus people in proximity to a smart meter are at risk of significantly greater aggregate exposure than with a cell phone, not to mention the cumulative levels of RF/microwaves that people living near several meters are exposed to.

People are exposed to cell phone microwaves primarily in the head and neck, and only when they use their device. With smart meters, the entire body is exposed to the microwaves, which increases the risk of overexposure to many organs.

In addition to these erratic bursts of modulated microwaves coming from smart meters that are transferring usage data to electric, gas and water utilities, wireless and wired smart (powerline communication) meters are also a major source of “dirty electricity” (electrical interference of high frequency voltage transients typically of kilohertz frequencies). Indeed, some scientists, such as [American epidemiologist Sam Milham](#), believe that many of the health complaints about smart meters may also be caused by dirty electricity generated by the « switching » power supply activating all smart meters. Since the [installation of filters to reduce dirty electricity](#) circulating on house wiring has been found to relieve symptoms of EHS in some people, this method should be considered among the priorities aimed at reducing potential adverse impacts.

Rather be safe than sorry

The apparent adverse health effects noted with smart meter exposure are likely to be further

exacerbated if smart appliances that use wireless communications become the norm and further increase unwarranted exposure.

To date, there have been few independent studies of the health effects of such sources of more continuous but lower intensity microwaves. However, we know after decades of studies of hazardous chemical substances, that chronic exposure to low concentrations of microwaves can cause equal or even greater harm than an acute exposure to high concentrations of the same microwaves.

This is why so many scientists and medical experts urgently recommend that measures following the Precautionary Principle be applied immediately — such as using wired meters — to reduce biologically inappropriate microwave exposure. We are not advocating the abolishment of RF technologies, only the use of common sense and the development and implementation of best practices in using these technologies in order to reduce exposure and risk of health hazards.

[1. Scientific papers on EMF health effects](#)

[2. Explanation and studies on electrosensitivity](#)

[3. Governments and organizations that ban or warn against wireless technology](#)

- [David O. Carpenter](#), MD, Director, Institute for Health & the Environment, University at Albany, USA
- [Jennifer Armstrong](#), MD, Past President, Canadian Society of Environmental Medicine, Founder, Ottawa Environmental Health Clinic, Ontario, Canada
- Pierre L. Auger, M. D., FRCPC, Occupational medicine, Multiclinique des accidentés 1464, Montreal, Quebec, Canada
- [Fiorella Belpoggi](#), Director Cesare Maltoni Cancer Research Center, Ramazzini Institute, Bologna, Italy
- [Martin Blank](#), PhD, former President, Bioelectromagnetics Society, Special Lecturer, Department of Physiology and Cellular Biophysics, Columbia University Medical Center, New York, USA
- [Barry Breger](#), MD, Centre d'intégration somatosopique (orthomolecular medicine), Montreal, Quebec
- [John Cline](#), MD, Professor, Institute for Functional Medicine, Federal Way, WA, USA, Medical Director, Cline Medical Centre, Nanaimo, BC, Canada
- [Alvaro Augusto de Salles](#), PhD, Professor of Electrical Engineering, Federal University of Rio Grande do Sul, Porto Alegre, Brazil
- [Christos Georgiou](#), Prof. Biochemistry, Biology Department, University of Patras, Greece
- [Andrew Goldsworthy](#), PhD, Honorary lecturer in Biology, Imperial College, London, UK
- [Claudio Gómez-Perretta](#), MD, PhD, Director, Centro de Investigación, Hospital Universitario LA Fe, Valencia, Spain
- [Livio Giuliani](#), PhD, Senior Researcher, National Insurance Institute (INAIL), Chief of Radiation and Ultrasounds Research Unit, Rome, Italy
- [Yury Grigoriev](#), PhD, Chair Russian National Committee on Non-Ionizing Radiation Protection, Moscow, Russia
- [Settimio Grimaldi](#), PhD, Director, Institute of Translational Pharmacology (Neurobiology and molecular medicine), National Research Council, Rome, Italy
- [Magda Havas](#), PhD, Centre for Health Studies, Trent University, Canada
- [Lennart Hardell](#), MD, Professor of Oncology, University Hospital, Örebro, Sweden
- [Denis L. Henshaw](#), PhD, Professor of Physics, Head of The Human Radiation Effects Group, University of Bristol, UK
- [Ronald B. Herberman](#), MD, Chairman of Board, Environmental Health Trust, and Founding Director emeritus, University of Pittsburgh Cancer Institute, USA
- [Isaac Jamieson](#), PhD Environmental Science (electromagnetic phenomena in the built environment), independent architect, scientist and environmental consultant, Hertfordshire, UK

- [Olle Johansson](#), PhD, Professor of Neuroscience (Experimental Dermatology Unit), Karolinska Institute, Stockholm, Sweden
- [Yury Kronn](#), PhD, Soviet authority on physics of nonlinear vibrations and high frequency electromagnetic vibrations, founder of Energy Tools International, Oregon, USA
- [Henry Lai](#), PhD, Professor of Bioengineering, University of Washington School of Medicine, Seattle, WA, USA
- [Abraham R. Liboff](#), PhD, Professor Emeritus, Department of Physics, Oakland University, Rochester, Michigan, USA
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- [Andrew A. Marino](#), MD, PhD, JD, Professor of Neurology, LSU Health Sciences Center, Shreveport, LA, USA
- [Karl Maret](#), MD, M.Eng., President, Dove Health Alliance, Aptos, CA, USA
- [Sam Milham](#), MD, former chief epidemiologist, Washington State Department of Health, USA
- [Joel M. Moskowitz](#), PhD, Director, Center for Family and Community Health, School of Public Health, University of California, Berkeley
- [Gerd Oberfeld](#), MD, Public Health Department, Salzburg State Government, Austria
- [Jerry L. Phillips](#), PhD, Director, Center for Excellence in Science, Department of Chemistry and Biochemistry, University of Colorado, USA
- [William J. Rea](#), MD, thoracic and cardiovascular surgeon, founder of the Environmental Health Center, Dallas, Tx, USA
- [Elihu D. Richter](#), MD, Professor, Hebrew University-Hadassah School of Public Health and Community Medicine, Jerusalem, Israel
- [Cyril W. Smith](#), PhD, lead author of "Electromagnetic Man", retired from Electronic and Electrical Engineering, University of Salford, UK
- [Morando Soffritti](#), MD, Scientific Director of the European Foundation for Oncology and Environmental Sciences "B. Ramazzini" in Bologna, Italy
- [Antoinette "Toni" Stein](#), PhD, Collaborative on Health and the Environment (CHE-EMF Working Group), Co-Coordinator, Berkeley, CA, USA
- [Stanislaw Szmigielski](#), MD, PhD Professor of Pathophysiology, Consulting Expert, former director of Microwave Safety, Military Institute of Hygiene and Epidemiology, Warsaw, Poland
- [Bradford S. Weeks](#), MD, Director, The Weeks Clinic, Clinton, WA, USA
- [Stelios A. Zinelis](#), MD, Vice-President, Hellenic Cancer Society, Cefallonia, Greece

Coordination: Andre Fauteux, Publisher and Editor in chief, *la Maison du 21e siècle* [magazine](#), Sainte-Adele, Quebec, Canada.

<http://maisonsaine.ca/smart-meters-correcting-the-gross-misinformation/>

Health Experts Caution About Smart Meters

More than 50 scientists and medical professionals from 20 countries call for precaution regarding deployment of wireless “smart meters.”

Joel M. Moskowitz, PRLog Press Release, Sep 19, 2012

Fifty-three experts on the health effects of electromagnetic fields (EMFs) have called for “use of common sense and the development and implementation of best practices in using these technologies in order to reduce exposure and risk of health hazards.”

These scientists and medical professionals who come from twenty countries have published hundreds of peer-reviewed studies on the health effects of EMFs.

Following are excerpts from the open letter they signed, **"Smart Meters: Correcting the Gross Misinformation"**:

- “the mass deployment of smart grids could expose large chunks of the general population to alarming risk scenarios without their consent.”
- “many scientists and medical experts urgently recommend that measures following the Precautionary Principle be applied immediately such as using wired meters to reduce biologically inappropriate microwave exposure. We are not advocating the abolishment of RF technologies, only the use of common sense and the development and implementation of best practices in using these technologies in order to reduce exposure and risk of health hazards.”
- “the International Agency for Research on Cancer (IARC) classified radiofrequency radiation as a 2B, possible human carcinogen“
- “Children are especially at risk.”
- “While the specific pathways to cancer are not fully understood, it is scientifically unacceptable to deny the weight of the evidence regarding the increase in cancer cases in humans that are exposed to high levels of RF/microwave radiation”
- “more than 1,000 studies done on low intensity, high frequency, non-ionizing radiation, going back at least fifty years, show that some biological mechanisms of effect do not involve heat. This radiation sends signals to living tissue that stimulate biochemical changes, which can generate various symptoms and may lead to diseases such as cancer.”
- “this energy can cause DNA damage indirectly leading to cancer by a combination of biological effects. Recent publications have documented the generation of free radicals, increased permeability of the blood brain barrier allowing potentially toxic chemicals to enter the brain, induction of genes, as well as altered electrical and metabolic activity in human brains upon application of cell phone RF/microwaves similar to those produced by smart meters.”

- "High frequency EMFs such as the microwaves used in cell phones, smart meters, Wi-Fi and cordless "DECT" phones, appear to be the most damaging when used commonly."
- "authorities are worried about the growing number of citizens who say they have developed electrohypersensitivity (EHS), especially since for many of them, the symptoms developed after the installation of such meters."
- "adverse neurological effects have been reported in people who sustain close proximity to wireless meters, especially under 10 feet"
- "Wireless smart meters typically produce atypical, relatively potent and very short pulsed RF/microwaves whose biological effects have never been fully tested. They emit these millisecond-long RF bursts on average 9,600 times a day with a maximum of 190,000 daily transmissions and a peak level emission two and a half times higher than the stated safety signal"
- "People in proximity to a smart meter are at risk of significantly greater aggregate of RF/microwave exposure than with a cell phone, not to mention the cumulative exposure received by people living near multiple meters mounted together, pole-mounted routers or utility collector meters using a third antenna to relay RF signals from 500 to 5,000 homes."
- "RF levels from various scenarios depicting normal smart meter installation and operation may violate even the out-of-date US public safety standards which only consider acute thermal effects."
- "caution is warranted because the growing variety of RF/microwave emissions produced by many wireless devices such as smart meters have never been tested for their potential biological effects."

Dr. David Carpenter, founder of the University of Albany (NY) School of Public Health, drafted the original letter with input from experts from many countries. The letter was just updated and signed by many additional scientists and medical professionals from all five continents. In the U.S., co-signers include researchers at Columbia University, Michigan State University, the University of California at Berkeley, the University of Colorado, the University of Pittsburgh, and the University of Washington.

In addition to the need to take precaution, we need research to develop safer technologies that will reduce our exposure to electromagnetic radiation from wireless devices including smart meters, Wi-Fi, and cell phones. The Federal government needs to fund a major research initiative that is independent of industry to prevent conflicts of interest. This research could be supported by a small fee of 50 cents per year assessed on each cell phone.

The open letter, a list of the 54 experts who signed it and their affiliations, and links to supplementary resources are available at: <http://maisonsaine.ca/smart-meters-correcting-the-gross-misinformation/>

André Fauteux, Editor, La Maison du 21e siècle magazine, Sainte-Adèle, Quebec info@maisonsaine.ca
450 228-1555

<http://www.prlog.org/11978228.html>

**Adoption of Wi-Fi in Los Angeles USD Classrooms
(Open Letter e-mailed to LAUSD Staff and School Board)**

TO: Los Angeles Unified School District (LAUSD)

FROM: Joel M. Moskowitz, Ph.D.
Director, Center for Family and Community Health
School of Public Health
University of California, Berkeley

RE: Adoption of Wi-Fi in Classrooms

DATE: February 8, 2013

Based upon my review of the research of the health effects associated with exposure to radiofrequency (RF) electromagnetic radiation (EMR), especially microwave radiation, I feel compelled to register my concern that adoption of Wi-Fi in LAUSD classrooms is likely to put at risk the health of many students and employees in the District.

In December, Dr. Gayle Nicoll of URS Corporation asked me to serve as an expert reviewer for a report that URS prepared for the LAUSD regarding the adoption of Wi-Fi in classrooms. Since Ms. Nicoll could not assure me that URS has no conflicts of interest, I turned down her request and sent her references to recent studies about Wi-Fi radiation. I cc:ed Board members and key staff as I was concerned about the health risks of unnecessarily subjecting 660,000 children to 13,000 hours of Wi-Fi microwave radiation during their K-12 school years.

Although I have not seen the URS report, I imagine it is based on the FCC's outmoded 1996 safety standards which only protect the public from the thermal risk of RF EMR exposure (i.e., from heating of tissue). For the past three years, in numerous media interviews I have been calling on the FCC to strengthen its standards and testing procedures to protect the public and workers from the low-intensity, non-thermal risks of RF EMR exposure that have been reported in hundreds, if not thousands, of research studies. These include increased risk of neurological and cardiovascular problems, sperm damage and male infertility, reproductive health risks, and cancer.

The precautionary principle should be applied to this critical policy decision. This principle, developed at a U.N. environmental conference in 1992, states that in the absence of scientific consensus if an action has a suspected risk of causing harm, the burden of proof it is not harmful falls on those taking the action, and all reasonable measures to reduce the risk must be taken.

Internet access can be provided to students through wires or optical fiber without installing Wi-Fi in the classrooms.

For further information, please see my Electromagnetic Radiation Safety web site at <http://saferemr.blogspot.com> where I have archived news releases and links to recent reports by major scientific groups and political agencies.

Sincerely,

Joel M. Moskowitz, Ph.D.

<http://saferemr.blogspot.com/2013/02/adoption-of-wi-fi-in-los-angeles-usd.html>

**Wireless Industry's Patented System to Reduce Cancer Risk
from Wireless Local Networks Never Adopted**

A major telecom company patented a system to reduce "electrosmog" from wireless local networks to reduce cancer risks associated with non-thermal exposures to microwave radiation. The industry has known the risks for many years but has failed to act.

Joel M. Moskowitz, PRLog (Press Release), Mar 11, 2013

Swisscom AG, a major telecommunications provider in Switzerland, filed U.S. and international patent applications for an innovative system to reduce "electrosmog" from wireless local networks (i.e., Wi-Fi) in 2003.

This patent application acknowledged the cancer risk from exposure to wireless radiation eight years before the WHO's International Agency for Research on Cancer declared that radiofrequency energy, including cell phone and Wi-Fi radiation, is a "possible carcinogen" to humans, like DDT and lead.

Furthermore, the application acknowledged that low-intensity, non-thermal exposures to wireless radiation is genotoxic. This is critical because the current U.S. regulatory standard for wireless radiation, established in 1996, does not protect us from non-thermal exposures.

According to this 2003 patent application, the "influence of electrosmog on the human body is a known problem." (1) The application states:

"The health risk from mobile radio transmitters, handys (i.e., cell phones) and DECT (i.e., cordless) telephones has been an explosive subject among the general public at least since the enormous breakthrough in mobile radio technology in the 1990s. To meet the concerns of science from the legislative side, the permissible limit values have thus been lowered several times, and technology has been increasingly focused on this problem. The risk of damage to health through electrosmog has also become better understood as a result of more recent and improved studies. When, for example, human blood cells are irradiated with electromagnetic fields, clear damage to hereditary material has been demonstrated and there have been indications of an increased cancer risk (Mashevich et al., 2003) ... an aneuploidy (=numerical chromosome aberration) - was observed as a function of the SAR, demonstrating that this radiation has a genotoxic effect ... These findings indicate that the genotoxic effect of electromagnetic radiation is elicited via a non-thermal pathway. Moreover aneuploidy is to be considered as a known phenomenon in the increase of cancer risk." (1)

The application further explains:

"Thus it has been possible to show that mobile radio radiation can cause damage to genetic material, in particular in human white blood cells, whereby both the DNA itself is damaged and the number of chromosomes changed. This mutation can consequently lead to increased cancer risk. In particular, it could also be shown that this destruction is not dependent upon temperature increases, i.e. is non-thermal. Based on the scientific studies in the field, and owing to increasing pressure from the public, especially in the industrialized countries, epidemiological studies have been systematized by the World Health Organization (WHO) in the last few years, such as e.g. the currently running WHO Interphone Project, in order to be able to assess more precisely the health risks from electrosmog and work out corresponding guidelines." (1)

The proposed system works as follows. After a specified time without a connecting signal, the base station in this system switches from the normal transmitting/receiving mode to a sleep mode in which no signals are transmitted. When a mobile unit, such as a tablet, laptop or smart phone, requires a network connection, it transmits an alert signal, and the base station switches back to its normal mode.

Ten years after this patent was filed, the system is unavailable. How many other harm reduction technologies have been patented by the Wireless Industry but never used to reduce our risk of cancer and other diseases associated with exposure to wireless radiation?

After its experience with tobacco and asbestos, it's no wonder that the insurance industry will not provide product liability insurance to the Wireless Industry (2). This patent application demonstrates that the Wireless Industry has known for many years the potential health risks from use of its technology. Yet the Industry continues to fight efforts to educate the public about these risks and blocks effective regulation of wireless radiation in the U.S. and in other countries.

Fifteen nations and the European Union have issued precautionary health warnings about cell phone radiation. However, efforts at the Federal, state, and local level in the U.S. have repeatedly been blocked by political and legal opposition from the CTIA, the Wireless Industry's lobbying arm.

Instead, the Industry promotes installation of cell phone towers, Wi-Fi, and wireless Smart Meters everywhere without regard to the population's overall exposure to microwave radiation. Many people are likely to suffer serious health consequences from this massive increase in electrosmog.

Based upon our nation's experience with other industries like tobacco and asbestos, the Wireless Industry will likely procrastinate taking action to reduce harm until it is faced with huge product liability settlements. Unfortunately, it may take awhile before such lawsuits are successful since the Industry has co-opted many scientists, and the scientific literature has mixed findings that enable industry experts to confuse juries.

Based upon the precautionary principle, policy makers should adopt effective regulation now to protect us from this emerging threat to public health. Strong public support is needed to overcome the Industry's political power.

For more information about wireless radiation health effects and health policy, see my Electromagnetic Radiation Safety web site at <http://saferemr.com> and my saferemr Facebook page which has links to the BioInitiative 2012 Report and the new European Environment Agency report. For regular updates on this and other health promotion issues, subscribe to my Twitter account @berkeleyprc.

References

(1) "Reduction of Electrosmog in Wireless Local Networks." WIPO: Patentscope. International Patent Application No. PCT/CH2003/000138. URL:

<http://patentscope.wipo.int/search/en/detail.jsf?docId=WO2004075583>

(2) Lloyd's Emerging Risks Team Report (version 2.0). "Electro-magnetic Fields from Mobile Phones: Recent Developments." Nov. 2010. URL: <http://www.lloyds.com/The-Market/Tools-and-Resources/Research/Exposure-Management/Emerging-risks/Emerging-Risk-Reports/Health/EMF>

<http://www.prlog.org/12094566-wireless-industrys-patented-system-to-reduce-cancer-risk-from-wireless-local-networks-never-adopted.html>

Boeing Tests In-Flight Wireless on Potatoes, Not People

Should we allow airlines to adopt wi-fi and cellular systems on airplanes? Given the latest health research and our outmoded FCC wireless regulations, is this safe for humans, especially for pregnant women and children?

Joel M. Moskowitz, PRLog (Press Release), Dec. 19, 2012

A CNN headline today reads, "Boeing uses potatoes for in-flight wireless test" (Aaron Cooper, CNN, December 19, 2012: <http://www.cnn.com/2012/12/19/travel/potatoes-wireless/>).

Perhaps wi-fi radiation does not affect potatoes, but what about human health effects?

Given the latest research on secondhand exposure to microwave radiation, how confident can a bunch of engineers be that there are no health effects, especially for pregnant women and children, due to exposure to wi-fi in an airplane cabin that functions like a Faraday cage (1)?

Just because wi-fi on planes may comply with outmoded FCC standards does not make it safe for humans (2).

What about the growing number of people who suffer from electromagnetic hypersensitivity -- are they supposed to stop flying?

With a few exceptions, policy makers in the U.S. have largely ignored warnings from American health scientists like Devra Davis, David Carpenter, Hugh Taylor, Jonathan Samet, and myself about the long-term health effects associated with exposure to wireless microwave radiation. Meanwhile a dozen other nations have issued precautionary health warnings, and some have increased restrictions on use of wi-fi and cell phones especially among children.

(1) Secondhand Exposure to Cell Phone Radiation: An Emerging Public Health Problem?
<http://www.prlog.org/12010018>

(2) Does The FCC Plan To Rubber Stamp Outdated Cell Phone Radiation Standards?
<http://www.prlog.org/11901340>

For more information about the health effects associated with exposure to electromagnetic radiation, see ...

<http://ehtrust.org>
<http://electromagnetichealth.org>
<http://www.ewg.org/cellphone-radiation>
<http://www.microwavenews.com>

Cell Phones: Assessing and Preventing Risks, a Q&A I did with Dr. David Katz
http://www.huffingtonpost.com/david-katz-md/cell-phone-health-risks_b_869241.html

<http://www.prlog.org/12046596-boeing-tests-in-flight-wireless-on-potatoes-not-people.html>

Children's Cell Phone Use May Increase Their Risk of ADHD

A new study finds that children who use cell phones who are exposed to lead are at greater risk of developing Attention Deficit Hyperactivity Disorder (ADHD) than lead-exposed children who do not use cell phones much or at all.

Joel M. Moskowitz, PRLog Press Release, Apr 27, 2013

Eleven percent of American children have been diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) including nearly one in five high school age boys according to a recent report by the Centers for Disease Control and Prevention. (1)

Although we may be over-diagnosing ADHD and over-medicating children for this disorder, the 53 percent increase in ADHD diagnoses during the past decade may be attributable in part to increased exposure to environmental toxins in conjunction with exposure to microwave radiation from cell phones.

A research study published last week in ***PLoS One*** found that children exposed to lead who made more voice calls on their cell phone were at significantly greater risk of developing ADHD symptoms. Moreover, a significant dose-response relationship was observed between the number and duration of voice calls made on cell phones and ADHD risk among children exposed to lead in their environment. (2)

In this longitudinal study, 2,422 children at 27 elementary schools from 10 cities in South Korea were examined and followed up two years later. One fourth of the students were considered "lead-exposed," defined as having a blood lead level of at least 2.35 micrograms per deciliter. (2) In the U.S., about 5% of children ages 6-11 have blood lead levels of 2.5 or higher. (3) Since there are currently 25.2 million children in this age group (4), about 1.3 million American children could be at risk of ADHD if they are heavier cell phone users.

In the current study, heavier cell phone users either made 3 or more outgoing voice calls a day on average, spent a minute or more on calls, or logged 70 or more hours of calls in their lifetime. These children had 2-3 times the odds of developing ADHD symptoms as compared to other "lead-exposed" children who had minimal or no cell phone use.

The paper reviewed prior research which has shown (a) that exposure to radiofrequency electromagnetic fields can increase cognitive impairment and behavioral disorders including hyperactivity; (b) that lead is a neurotoxin which can cause ADHD and other cognitive problems; and (c) that exposure to electromagnetic fields increases the permeability of the blood-brain barrier. Thus, combining these two exposures, lead and cell phone radiation, could be a particularly toxic combination.

Prior studies conducted by researchers in Los Angeles have found increased behavioral problems reported by mothers of children in Denmark who were exposed to cell phone radiation pre- and post-natally. (5, 6)

A recent experimental study conducted by researchers at Yale University found that mice exposed prenatally to cell phone radiation later exhibited ADHD-like symptoms, and the degree of impairment was related to the number of hours of prenatal cell phone exposure. (7)

In the U.S., exposure to lead is quite common as it can be found in a variety of sources including paint in homes built before 1978; water pumped through leaded pipes; imported items like clay pots; certain consumer products (e.g., candies, makeup and jewelry); and certain imported home remedies.

Although the current longitudinal study has some limitations, the authors made the following recommendation:

“preventing the use of mobile phones in children may be one measure to keep children from developing ADHD symptoms regardless of the possible roles of mobile phone use in ADHD symptoms, i.e., whether potentiating the effect of lead exposure due to RF exposure and voice calls or behavioral aggravation due to high rates of playing games on a mobile phone.”

References

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(2) Byun Y-H, Ha M, Kwon H-J, Hong Y-C, Leem J-H, et al. (2013) Mobile Phone Use, Blood Lead Levels, and Attention Deficit Hyperactivity Symptoms in Children: A Longitudinal Study. PLoS ONE 8(3): e59742. doi:10.1371/journal.pone.0059742.

Abstract

Background Concerns have developed for the possible negative health effects of radiofrequency electromagnetic field (RF-EMF) exposure to children's brains. The purpose of this longitudinal study was to investigate the association between mobile phone use and symptoms of Attention Deficit Hyperactivity Disorder (ADHD) considering the modifying effect of lead exposure.

Methods A total of 2,422 children at 27 elementary schools in 10 Korean cities were examined and followed up 2 years later. Parents or guardians were administered a questionnaire including the Korean version of the ADHD rating scale and questions about mobile phone use, as well as socio-demographic factors. The ADHD symptom risk for mobile phone use was estimated at two time points using logistic regression and combined over 2 years using the generalized estimating equation model with repeatedly measured variables of mobile phone use, blood lead, and ADHD symptoms, adjusted for covariates.

Results The ADHD symptom risk associated with mobile phone use for voice calls but the association was limited to children exposed to relatively high lead.

Conclusions The results suggest that simultaneous exposure to lead and RF from mobile phone use was associated with increased ADHD symptom risk, although possible reverse causality could not be ruled out.

<http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0059742>

(3) Exhibit 5-2. Blood lead concentrations for the U.S. population age 1 year and older by selected demographic groups. Environmental Protection Agency. URL: <http://cfpub.epa.gov/eroe/index.cfm?fuseaction=detail.viewInd&lv=list.listbyalpha&r=224030&subtop=208>

(4) POP1 Child population: Number of children (in millions) ages 0–17 in the United States by age, 1950–2011 and projected 2012–2050. Forum on Child and Family Statistics: ChildStats.gov. URL: <http://www.childstats.gov/americaschildren/tables/pop1.asp>

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<http://www.prlog.org/12110138>

Secondhand Exposure to Cell Phone Radiation: An Emerging Public Health Problem?

Exposure to other people's cell phone radiation on buses and trains can be considerable according to a newly published study.

Joel M. Moskowitz, PRLog (Press Release), Oct 29, 2012

Many people are unaware that they are exposed to cell phone radiation when their cell phones are in standby mode. This occurs because their cell phone contacts the nearest cell tower periodically to update its location.

In a moving vehicle, cell phones in standby mode contact cell towers more frequently. Thus, exposure to cell phone radiation from one's cell phone is greater in transit.

Two Swiss researchers, Damiano Urbinello and Martin Roosli, set out to measure personal cell phone radiation exposure during car, bus and train trips when one's own phone was in standby mode.

Their study just published in the ***Journal of Exposure Science and Environmental Epidemiology*** identified a source of cell phone radiation that may constitute a public health problem. Namely, secondhand exposure to cell phone radiation from other people's cell phones can be considerable while traveling on buses and trains (1).

During bus or train trips, individuals may be exposed to considerable amounts of cell phone radiation from other people's cell phones. Buses and railroad cars act like "Faraday cages" that reflect much of the electromagnetic radiation emitted by cell phones throughout the vehicles' interiors. Thus, all passengers, including infants and pregnant women as well as those without cell phones, may be exposed to considerable levels of cell phone radiation emitted by others' phones.

As for **car trips**, the results of the study suggest that exposure to cell phone radiation from one's own phone in standby mode is relatively low compared to overall exposures during public transit. Nonetheless, those who are concerned about their exposure to cell phone radiation should turn off their phones during car trips, or at the very least, avoid using their phones for calls.

- "The study indicates that own uplink exposure during car driving can be considerably reduced (about a fraction of 100) when turning off ones own mobile phone in order to prevent it from location updates." (1)

The researchers found that GSM, the 2G carrier system in Europe which is used in the U.S. for voice communication by AT&T and T-Mobile, is particularly problematic compared to UMTS, a 3G carrier system used for data transmission. The researchers did not test CDMA which in the U.S. is used by Verizon and Sprint for voice calls. Other research has found that GSM emits 13 to 28 times more radiation on average than CDMA during phone calls. No published studies have examined exposures from LTE, the 4G carrier system now in widespread use in this country.

- "GSM levels in the reference scenario during bus and train rides were about 100 times higher than those during car rides. As a consequence of this high background exposure in trains, due to the use of other people's mobile phone in a closed area intensified by the Faraday cage effect, the relative contribution of the location update from ones own mobile phone is small" (1)

The study also reported that smart phones, including the iPhone 4 and the Blackberry Bold 8800, which can operate on four radiofrequency bands emit more radiation during standby mode than classic phones,

like the Nokia 2600, which operate on two bands.

Earlier this year, a study was published that examined cell phones in standby mode while stationary. Kjell Mild and his colleagues from Sweden found that under these conditions cell phones contacted the cell towers only once every two to five hours. They concluded that exposure to cell phone radiation in this situation "can be considered negligible." (2)

These studies should be replicated in the U.S. as well as in other countries since every cell phone carrier system operates differently.

In the meantime it is advisable to keep cell phone use in moving vehicles to a minimum as low level exposures to cell phone radiation have been associated with deleterious effects in humans.

To protect us from the health risks associated with cell phones and related devices (e.g., cordless phones, Wi-Fi, wireless Smart Meters and security systems, and cell towers), we need research independent of industry to develop biologically-based standards and safer technologies. **A nickel a month from each cell phone subscription would suffice to fund a comprehensive program of research.** Since the average cell phone subscription costs more than \$47.00 per month, this tiny fee constitutes a prudent investment in our health and our children's health.

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Source Department of Epidemiology and Public Health, Swiss Tropical and Public Health Institute, Basel, Switzerland and the University of Basel, Basel, Switzerland.

Abstract

When moving around, mobile phones in stand-by mode periodically send data about their positions. The aim of this paper is to evaluate how personal radiofrequency electromagnetic field (RF-EMF) measurements are affected by such location updates. Exposure from a mobile phone handset (uplink) was measured during commuting by using a randomized cross-over study with three different scenarios: disabled mobile phone (reference), an activated dual-band phone and a quad-band phone. In the reference scenario, uplink exposure was highest during train rides (1.19 mW/m(2)) and lowest during car rides in rural areas (0.001 mW/m(2)). In public transports, the impact of one's own mobile phone on personal RF-EMF measurements was not observable because of high background uplink radiation from other people's mobile phone. In a car, uplink exposure with an activated phone was orders of magnitude higher compared with the reference scenario. This study demonstrates that personal RF-EMF exposure is affected by one's own mobile phone in stand-by mode because of its regular location update. Further dosimetric studies should quantify the contribution of location updates to the total RF-EMF exposure in order to clarify whether the duration of mobile phone use, the most common exposure surrogate in the epidemiological RF-EMF research, is actually an adequate exposure proxy.

<http://www.ncbi.nlm.nih.gov/pubmed?term=23093102>

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Abstract

Several studies have been using a GSM mobile phone in stand-by mode as the source for exposure, and they claimed that this caused effects on for instance sleep and testicular function. In stand-by mode the phone is only active in periodic location updates, and this occurs with a frequency set by the net operator. Typical updates occur with 2-5 h in between, and between these updates the phone is to be considered as a passive radio receiver with no microwave emission. Thus, the exposure in stand-by mode can be considered negligible.

<http://informahealthcare.com/doi/abs/10.3109/15368378.2011.624232>

<http://www.prlog.org/12010018-secondhand-exposure-to-cell-phone-radiation-an-emerging-public-health-problem.html>

LTE Cell Phone Radiation Affects Brain Activity in Cell Phone Users

New peer-reviewed research finds that 30 minutes' exposure to LTE cellphone radiation affects brain activity on both sides of the brain.

Joel M. Moskowitz, PRLog (Press Release), Sep 23, 2013

The first study on the short-term effects of Long Term Evolution (LTE), the fourth generation cell phone technology, has been published online in the peer-reviewed journal, ***Clinical Neurophysiology***. (1)

In a controlled experiment, researchers exposed the right ear of 18 participants to LTE cellphone radiation for 30 minutes. The source of the radiation was 1 centimeter from the ear, and the absorbed amount of radiation in the brain was well within international (ICNIRP) cell phone legal limits. The researchers employed a double-blind, crossover, randomized and counter-balanced design to eliminate any possible study biases.

The resting state brain activity of each participant was measured by magnetic resonance imaging (fMRI) at two times -- after exposure to LTE microwave radiation, and after a sham exposure.

The results demonstrated that LTE exposure affected brain neural activity not only in the closer brain region but also in the remote region, including the left hemisphere of the brain. The study helps explain the underlying neural mechanism for the remote effects of microwave radiation in the brain.

In 2011, Dr. Nora Volkow, Director of the National Institute on Drug Abuse, published a similar study in the ***Journal of the American Medical Association*** that received worldwide news coverage. Dr. Volkow reported that a 50 minute exposure to CDMA, a second generation cell phone technology, increased brain activity in the region of the brain closest to the cell phone. (2)

The current study establishes that short-term exposure to LTE microwave radiation affects the users' brain activity. Although LTE is too new for the long-term health consequences to have been studied, we have considerable evidence that long-term cell phone use is associated with various health risks including increased risk of head and neck cancers, sperm damage, and reproductive health consequences for offspring (i.e., ADHD).

Cell phone users, especially pregnant women and children, should limit their cell phone use. Moreover, cell phone users should not keep their phones near their head, breasts or reproductive organs when using the phone or whenever the phone is turned on unless it is in airplane mode.

References

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Abstract

Objective The motivation of this study is to evaluate the possible alteration of regional resting state brain activity induced by the acute radiofrequency electromagnetic field (RF-EMF) exposure (30 min) of Long Term Evolution (LTE) signal.

Methods We designed a controllable near-field LTE RF-EMF exposure environment. Eighteen subjects

participated in a double-blind, crossover, randomized and counterbalanced experiment including two sessions (real and sham exposure). The radiation source was close to the right ear. Then the resting state fMRI signals of human brain were collected before and after the exposure in both sessions. We measured the amplitude of low frequency fluctuation (ALFF) and fractional ALFF (fALFF) to characterize the spontaneous brain activity.

Results We found the decreased ALFF value around in left superior temporal gyrus, left middle temporal gyrus, right superior temporal gyrus, right medial frontal gyrus and right paracentral lobule after the real exposure. And the decreased fALFF value was also detected in right medial frontal gyrus and right paracentral lobule.

Conclusions The study provided the evidences that 30 min LTE RF-EMF exposure modulated the spontaneous low frequency fluctuations in some brain regions.

Significance With resting state fMRI, we found the alteration of spontaneous low frequency fluctuations induced by the acute LTE RF-EMF exposure.

<http://www.ncbi.nlm.nih.gov/pubmed/24012322>

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Abstract

CONTEXT: The dramatic increase in use of cellular telephones has generated concern about possible negative effects of radiofrequency signals delivered to the brain. However, whether acute cell phone exposure affects the human brain is unclear.

OBJECTIVE: To evaluate if acute cell phone exposure affects brain glucose metabolism, a marker of brain activity.

DESIGN, SETTING, AND PARTICIPANTS: Randomized crossover study conducted between January 1 and December 31, 2009, at a single US laboratory among 47 healthy participants recruited from the community. Cell phones were placed on the left and right ears and positron emission tomography with ((18)F) fluorodeoxyglucose injection was used to measure brain glucose metabolism twice, once with the right cell phone activated (sound muted) for 50 minutes ("on" condition) and once with both cell phones deactivated ("off" condition). Statistical parametric mapping was used to compare metabolism between on and off conditions using paired t tests, and Pearson linear correlations were used to verify the association of metabolism and estimated amplitude of radiofrequency-modulated electromagnetic waves emitted by the cell phone. Clusters with at least 1000 voxels (volume >8 cm³) and P < .05 (corrected for multiple comparisons) were considered significant.

MAIN OUTCOME MEASURE: Brain glucose metabolism computed as absolute metabolism ($\mu\text{mol}/100\text{ g per minute}$) and as normalized metabolism (region/whole brain).

RESULTS: Whole-brain metabolism did not differ between on and off conditions. In contrast, metabolism in the region closest to the antenna (orbitofrontal cortex and temporal pole) was significantly higher for on than off conditions (35.7 vs 33.3 $\mu\text{mol}/100\text{ g per minute}$; mean difference, 2.4 [95% confidence interval, 0.67-4.2]; P = .004). The increases were significantly correlated with the estimated electromagnetic field amplitudes both for absolute metabolism (R = 0.95, P < .001) and normalized metabolism (R = 0.89; P

< .001).

CONCLUSIONS: In healthy participants and compared with no exposure, 50-minute cell phone exposure was associated with increased brain glucose metabolism in the region closest to the antenna. This finding is of unknown clinical significance.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3184892/>

<http://www.prlog.org/12215083-lte-cell-phone-radiation-affects-brain-activity-in-cell-phone-users.html>

Samsung Scores with Lowest Radiation Cell Phones: Why Samsung Phones are a "Win-Win"

Samsung adopted an enhanced antenna system in 2006 to "enhance handset safety by radiating most of the transmitted RF energy away from the handset user" and improve radio frequency performance. Why haven't more manufacturers followed suit?

Joel M. Moskowitz, PRLog (Press Release), Aug 29, 2012

Samsung adopted an enhanced antenna system in 2006 to "enhance handset safety by radiating most of the transmitted RF energy away from the handset user" and "improve RF (radio frequency) performance". (1) Why haven't more manufacturers adopted modern antenna technology that both improves user safety and enhances cell phone performance?

Cell phones sold in the US vary in terms of their Specific Absorption Rate or SAR, the Federal government's measure of the maximum amount of microwave radiation absorbed by the head or body. A cell phone's SAR is assessed using an artificial laboratory model of a very large adult male. In the U.S., the SAR is measured in watts per kilogram averaged over one gram of tissue. (2) The lower the SAR, the less the user is exposed to microwave radiation.

Users of the 20 highest SAR cell phones sold in the US can absorb up to four times as much radiation in their heads as users of the 20 lowest SAR phones. (3)

Samsung sells twelve of the twenty lowest SAR phones available in the U.S. None of the lowest SAR phones are made by the leading U.S. companies, Apple, Motorola, or RIM Blackberry. (4)

In contrast, thirteen of the twenty highest SAR phones are sold by U.S. companies (eight Motorola and five RIM Blackberry), and none are sold by Samsung. (5)

The new Samsung Galaxy SIII smartphone has a maximum SAR of 0.48 watts per kilogram. (2) In comparison, the SAR for the Apple iPhone 4S is 1.11, and for the Motorola Droid Razr Maxx, it is 1.45. (2)

Among cell phones sold in the U.S., why are those produced by U.S. companies among the highest in user exposure to microwave radiation? It's time for U.S. companies to compete in terms of improving user safety. Moreover, Samsung has demonstrated that enhanced antenna technology can improve cell phone performance while it reduces microwave radiation absorption in the user's head and body. So adoption of this technology is a "win-win" for both the industry and the consumer.

All cell phones sold in the US must have a maximum SAR of 1.6 watts per kilogram averaged over one gram of tissue. Six countries have adopted the U.S. standard including Canada, Taiwan, New Zealand, South Korea, Bolivia, and recently, India. The cell phone industry, however, has been lobbying to weaken the U.S. standard because the ICNIRP or international standard allows up to 2.0 watts per kilogram averaged over ten grams of tissue. Although this may sound like a trivial difference, it is not because measuring radiation absorption over a larger volume of tissue averages out the "hot spots." Adoption of the ICNIRP standard in the U.S. could triple the amount of cell phone radiation absorbed by Americans. (6)

Although many researchers have questioned the utility of assessing only a cell phone's SAR, this is all that governments currently regulate. Throughout the world, governments want the public to believe that all legally marketed cell phones are safe, and that a cell phone's SAR doesn't matter as long as it meets

their certification test. The SAR standards, however, were developed decades ago to protect users only from the acute effects of the heat generated by microwave radiation, and do not protect users from non-thermal effects of cell phone radiation which may cause harm from long term exposure including increased cancer risk and sperm damage. (e.g., 7, 8)

For further discussion of why the SAR is inadequate for protecting your health and steps one can take to reduce risk, see the web sites for the Environmental Working Group and the Environmental Health Trust and prior news releases from the UC Berkeley Center for Family and Community Health. (9)

Note (9/4/2012 update): The SARs on the c|net website only pertain to the head SAR. The partial body SAR may be less than or greater than the head SAR. The Samsung Galaxy S3 in our example has a partial body SAR of 1.49 watts per kilogram.

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(2) c|net. Cell phone radiation levels. <http://reviews.cnet.com/cell-phone-radiation-levels/>

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"James Lin of the University of Illinois, Chicago, who was recently appointed a member of ICNIRP, has called this proposal to increase the averaging volume from 1g to 10g 'scientifically indefensible' (see MWN, J/A00 and N/D00). According to Lin, a limit of 2.0 W/Kg averaged over 10g would be approximately equivalent to an SAR of 4-6 W/Kg, averaged over 1g (see MWN, S/O01 and M/J03). Or to put it more simply, ICES wants to triple the amount of radiation you could get from a cell phone." (Slesin, 2005. Microwave News. January 14, 2005. <http://microwavenews.com/january-14-2005>)

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(9) Environmental Working Group. Where is EWG's cell phone database? http://www.ewg.org/cellphoneradiation/where_database

Environmental Health Trust: <http://www.saferphonezone.com>

UC Berkeley Center for Family and Community Health news releases:

<http://pressroom.prlog.org/jmm716>

<http://www.prlog.org/11962089>

**Comments on the 2012 GAO Report:
“Exposure and Testing Requirements for Mobile Phones Should Be Reassessed”**

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August 15, 2012 (Aug. 24, 2012 revision)

**Comments on the 2012 GAO Report:
“Exposure and Testing Requirements for Mobile Phones Should Be Reassessed”**

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August 15, 2012 (Aug. 24 revision)

U.S. General Accountability Office (GAO). *Exposure and Testing Requirements for Mobile Phones Should Be Reassessed*. GAO-12-771. Washington, DC: General Accountability Office.
<http://www.gao.gov/products/GAO-12-771> (accessed August 7, 2012)

Overview and General Comments

The GAO Report selectively reviewed scientific literature that supports the FCC's claim that cell phones which comply with the federal standards are safe. The GAO did not consider the methodologic limitations of this research or the alternative interpretations of the results from these studies. The GAO Report did not review the scientific evidence that strongly suggests the FCC standards which control only for thermal effects do not adequately protect the public from harm due to non-thermal effects of long-term exposure to cell phone radiation.

Although we do not have conclusive proof that cell phone radiation is harmful to humans, the FCC certainly cannot prove its claim that cell phones that comply with current federal standards are safe. The claim relies on many assumptions about the science. A critical review of the science—as opposed to simply “weighting the evidence”—reveals that these assumptions have dubious validity.

Evidence of harm from cell phone radiation

The opening statement of the GAO Report is factually incorrect:

"Scientific research has not demonstrated adverse human health effects of exposure to radio-frequency (RF) energy from mobile phone use, but research is ongoing that may increase understanding of any possible effects." (GAO Report, p. 1)

Numerous studies have demonstrated adverse health effects on humans associated with mobile phone use. Case-control research has found evidence for brain tumors (i.e., glioma, meningioma, and acoustic neuroma), and tumors of the parotid gland (Myung et al. 2009; Khurana et al., 2009). Considerable evidence exists for sperm damage caused by exposure to cell phone radiation, and increased male infertility associated with cell phone use (La Vignera et al, 2012). Preliminary evidence exists for reproductive health effects in children following *in utero* exposure to mobile phone radiation (Divan et al., 2008, 2012).

Many researchers with conflicts of interest reject this peer-reviewed research. They even dismiss their own data when the results provide evidence of adverse effects on human health. These researchers often argue that the trends in brain tumor incidence over time have been flat therefore the evidence of harm in these studies must be artifactual. However, many countries are witnessing increased incidence of specific tumors in population subgroups, if not in the overall population, associated with increased exposure over time to microwave radiation from cordless phones in addition to cell phones.

Alternatively, researchers with conflicts of interest typically argue there is no possible biologic mechanism; thus, the adverse health effects observed in their data should be dismissed. This ignores the fact that science commonly discovers causal effects before underlying mechanisms are understood. Nonetheless, numerous experimental studies have demonstrated potential mechanisms in animal models and cellular

studies caused by acute, non-thermal exposures to microwave radiation. The evidence includes penetration of the blood-brain barrier, generation of free radicals and heat shock proteins, single- and double-strand DNA damage, as well as sperm damage. Multiple peer-reviewed laboratory studies demonstrate each of these adverse effects (e.g., Behari, 2010). Recently, Volkow et al. (2011) demonstrated increased glucose metabolism in human brains after a brief (non-thermal) exposure to cell phone radiation.

The little research conducted on children and pregnant women suggests these two populations are at greatest risk of harm from cell phone radiation. The GAO report does not cite the work of Om Gandhi which finds that the child's brain absorbs much more microwave radiation than the adult's brain (Gandhi et al., 2012). According to Reardon (2011) "Several countries, including Russia, Germany, France, Israel, Finland, and the United Kingdom, have issued warnings against children using cell phones." Yet, the GAO Report does not discuss children's safety from cell phone radiation even though most children in the U.S. currently have cell phones.

FCC cell phone radiation standards

The history of cell phone radiation standard setting in the U.S. reveals the FCC's inability to oversee a process that ensures decision making free of conflict of interest. The FCC does not have the expertise to oversee the research needed to develop prudent standards.

In 1978, the U.S. Comptroller General (1978) issued a report to the Congress which recommended the potential need to regulate non-thermal effects of microwave radiation based upon a review of the research conducted by the FDA. However, 18 years later in 1996, when the FCC adopted the federal cell phone radiation standards, the Commission enacted standards that controlled only for the thermal effects of the microwave radiation emitted by mobile phones. The FCC adopted standards developed by two industry groups, first by IEEE in 1991 and subsequently by ANSI. These standard setting meetings were heavily dominated by engineers and physical scientists, not health scientists. At the time, the EPA was conducting research on microwave radiation and had found evidence of non-thermal effects; however, in early 1996, their funding for this research was terminated by the Congress. In 2004, the FCC issued a public request for input on some cell phone regulatory standards; however, eight years later the agency has yet to act upon this. Hence, the FCC still employs the standards developed 21 years ago when hardly anyone used cell phones even though almost all adults and most children now use this technology.

The Radiofrequency Interagency Working Group that advises the FCC on radiation-emitting consumer products including cell phones has been a failure. This arrangement diffuses responsibility which enables the participating agencies to point fingers at each other leading to inaction according to the GAO Report:

"According to senior FCC officials, the agency has not adopted any newer limit because federal health and safety agencies have not advised them to do so. FCC officials told us that they rely heavily on the guidance and recommendations of federal health and safety agencies when determining the appropriate RF energy exposure limit and that, to date, none of these agencies have advised FCC that its current RF energy limit needs to be revised. Officials from FDA and EPA told us that FCC has not formally asked either agency for an opinion on the RF energy limit. FDA officials noted, though, that if they had a concern with the current RF energy exposure limit, then they would bring it to the attention of FCC." (GAO Report, p. 18)

Given these historic failures, the FCC should not be trusted to oversee another review of the cell phone radiation standards. Most industry-funded scientists, as well as some government scientists, deny there is any risk from chronic non-thermal exposures to cell phone radiation. If the FCC oversees a review of the standards, the agency is likely to rely heavily on the IEEE once again and adopt regulations based only on thermal effects. Moreover, since 2006, the IEEE has been advocating that the U.S. adopt standards set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The GAO Report notes that more than 40 countries have adopted the weaker ICNIRP Specific Absorption Rate (SAR) standard, a measure of the amount of energy absorbed from a cell phone in a simulated head. The Report does not mention that six countries have adopted the U.S. SAR standard (Australia, Bolivia, Canada, New Zealand, South Korea, and recently, India). Nor does the Report mention that Russia, a

country that has conducted much of the health effects research on exposure to non-thermal levels of microwave radiation, has more stringent cell phone emission standards than the U.S.

Although the ICNIRP maximum specific absorption rate (SAR) of 2.0 watts per kilogram averaged over 10 grams of tissue does not sound very different from the U.S. maximum SAR of 1.6 watts per kilogram averaged over 1 gram of tissue, it actually represents a substantial difference because averaging heat absorption over a larger volume of tissue averages out the "hot spots":

"A mobile phone compliant with the ICNIRP standard of 2.0 W/kg SAR in 10 g of tissue may lead to a 2.5 to 3 times excess above the FCC standard of 1.6 W/kg in 1 g of tissue (i.e., 4–5 W/kg in a cube of 1 g of tissue)" (Gandhi and Kang, 2002)." (cited in Gandhi et al, 2012)

"James Lin of the University of Illinois, Chicago, who was recently appointed a member of ICNIRP, has called this proposal to increase the averaging volume from 1g to 10g 'scientifically indefensible' (see MWN, J/A00 and N/D00). According to Lin, a limit of 2.0 W/Kg averaged over 10g would be approximately equivalent to an SAR of 4-6 W/Kg, averaged over 1g (see MWN, S/O01 and M/J03). Or to put it more simply, ICES wants to triple the amount of radiation you could get from a cell phone." (Slesin, 2005)

Federal government negligent in funding cell phone radiation research

Although more research is needed to determine the long-term health consequences from continued exposure to non-thermal levels of cell phone radiation, little of this research is being conducted in the U.S. Nor are we conducting the research needed to develop safer standards and safer cell phone technology.

For the past 16 years, our federal health agencies have been negligent in funding research on the health effects of exposure to microwave radiation. The U.S. has also failed to participate in major international studies (e.g., Interphone, CEFALO, MOBI-KIDS, and COSMOS). The federal government has largely relied on industry to fund and conduct the research. From 1994-1999, the CTIA, the major wireless industry association, funded the Wireless Technology Research (WTR) Program, a \$25 million research initiative. In 2000, the CTIA funded a new research initiative, CRADA that was supposed to include FDA participation but did not. The intent of this initiative was to follow up on two studies that found harmful effects from low levels of cell phone radiation in the WTR program. Little research was published in the peer-reviewed literature from either of these industry-sponsored research programs.

The largest ongoing federally-funded study of exposure to cell phone radiation examines the health effects of 2G (i.e., second generation) cell phone technologies (GSM, CDMA) on mice and rats. The findings will be obsolete soon after the study is completed in 2015 because the industry is phasing out 2G. We should be conducting research on the health effects of 3G and 4G at this time. Some research suggests that DNA damage occurs at much lower exposures to 3G radiation than 2G. No health effects research has been published on 4G to date.

"According to representatives from the Mobile Manufacturers Forum, the association has provided about \$46 million for RF energy research since 2000 and is currently providing support for epidemiological and laboratory studies." (GAO Report, p. 16)

A major reason for the conflicting evidence about the health effects of cell phone radiation after more than two decades of research is because governments and the W.H.O. have relied on industry to fund all or part of the research. *Microwave News* has documented several incidents where industry-funded researchers lost their funding after reporting evidence of biologic activity in laboratory studies or harmful effects in humans. The corrupting influence of industry on the scientific community and on the health effects and biologic research has been chronicled for several decades by Louis Slesin in his newsletter, *Microwave News* (<http://microwavenews.com>), and was summarized by Devra Davis in her recent book, *Disconnect* (Davis, 2010).

If we hope to develop a body of high quality research that policy makers can rely upon, we must cultivate a scientific community that is independent of industry. A fee of fifty cents per year, or a penny per week,

assessed on each cell phone in the U.S. could generate \$150 million annually for research and education about cell phones and other forms of electromagnetic radiation.

GAO Report recommendations

The GAO Report makes two recommendations:

“We recommend that the Chairman of the FCC take the following two actions:

- Formally reassess the current RF energy exposure limit, including its effects on human health, the costs and benefits associated with keeping the current limit, and the opinions of relevant health and safety agencies, and change the limit if determined appropriate.
- Reassess whether mobile phone testing requirements result in the identification of maximum RF energy exposure in likely usage configurations, particularly when mobile phones are held against the body, and update testing requirements as appropriate.” (GAO Report, p. 28)

The GAO Report indicates that the industry and its affiliated organizations want the FCC to weaken the current standards by adopting the more permissive ICNIRP standards. In contrast, national environmental health organizations, which the Report refers to as “consumer groups,” demand that the FCC standards be strengthened, and the testing conditions be re-designed to better simulate real-world use of cell phones to ensure public safety.

Some environmental health groups and many scientists want supplemental standards developed to control for additional characteristics of cell phone radiation besides energy absorption (as measured by the SAR). These signal characteristics (frequency, modulation, etc.) are biologically active through non-thermal mechanisms. Considerable evidence exists that these non-thermal effects cause harm to human health as well as the health of other species (Fragopoulou et al., 2010; Juutilainen et al., 2011; Gandhi et al., 2012; Blank and Goodman, 2012). Cell phone regulatory standards should be designed to minimize these deleterious effects.

Based upon the FCC’s track record over the past several decades, the Congress should seriously consider assigning these tasks to a health agency with the requisite expertise and fund that agency to oversee the research and development of safety standards that ensure the protection of population health from **non-thermal** in addition to thermal risks associated with exposure to cell phone radiation.

The GAO Report’s second recommendation addresses a major deficiency in the FCC guidelines with regard to certification of cell phone safety. The FCC has failed to enforce its guideline that requires testing of cell phones in the manner in which they are used, namely, “against the ear and against the body.” Because the FCC allows cell phones to be tested from 1.5 to 2.5 cm (5/8 – 1 inch) away from the body and most users do not keep their phones this distance from their bodies, cell phones are being used unsafely much of the time based on the FCC’s safety definition. More importantly, users increase their risk of harm from microwave radiation by not using their phones the way they were tested.

The Report should also recommend to the FCC that its cell phone certification process employ artificial models, known as specific anthropomorphic mannequins, that resemble today’s cell phone users. The head of the mannequin in current use is modeled after an adult male in the 90th percentile of the military. People with smaller heads than the mannequin which includes most of the population absorb more radiation than the current test measures. Thus, most people are exposed to more microwave radiation from their cell phone than the FCC deems safe based on the current SAR standard.

The cell phone certification process should simulate who uses cell phones today including children, teenagers, pregnant women, males and females of reproductive age, seniors, and individuals with compromised immune systems and those who wear metal eyeglass frames or have metal fillings or braces on their teeth. The process should also simulate how cell phones are commonly used (e.g., directly against the head and body, in moving vehicles and in elevators).

Specific Comments

GAO Report:

“this report addresses (1) what is known about the health effects of RF energy from mobile phones and what are current research activities, (2) how FCC set the RF energy exposure limit for mobile phones, and (3) federal agency and industry actions to inform the public about health issues related to mobile phones, among other things.”

“FDA stated that while the overall body of research has not demonstrated adverse health effects, some individual studies suggest possible effects. Officials from NIH, experts we interviewed, and a working group commissioned by IARC—the World Health Organization’s agency that promotes international collaboration in cancer research—have reached similar conclusions. For example, in May 2011 IARC classified RF energy as “possibly IARC determined that the evidence from the scientific research for gliomas, a type of cancerous brain tumor, was limited—meaning that an association has been observed between RF energy exposure and cancer for which a causal relationship is considered to be credible, but chance, bias, or confounding factors could not be ruled out with reasonable confidence.” (GAO Report, pp. 6-7)

“Studies we reviewed suggested and experts we interviewed stated that epidemiological research has not demonstrated adverse health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have suggested a possible association with certain types of tumors, including cancerous tumors.” (GAO Report, p. 8)

Comment: Our research group published a review of the case-control research on mobile phone use and tumor risk in humans in the *Journal of Clinical Oncology* in 2009 that received worldwide attention (Myung et al, 2009a). **Our primary conclusion was that it is misleading to examine the overall weight of the evidence. Rather one must sort the studies based on research quality to see the true picture.**

Case-control studies that employed high quality research methods demonstrated a significant positive association between mobile phone use and tumor risk (i.e., increased risk). This association was stronger for brain tumors among those who used cell phones for 10 or more years, especially on the side of the head where the phone was held. In contrast, low quality studies displayed a significant negative association between mobile phone use and tumor risk (i.e., reduced risk or a protective effect from using cell phones). Thus, when we combined the estimates of tumor risk from the high and low quality studies, we found no overall risk. Many scientists in academia and government have focused on the overall weight of the evidence and have ignored the quality of the research. This is how they conclude we do not have adequate evidence. We also found that low quality studies tended to be funded all or in part by industry. Even the W.H.O. Interphone Study received one-fourth of its funding from industry. In contrast, high quality studies were more likely to be funded by government health agencies. Thus, conflicts of interest may have played a key role in the conduct and reporting of the research (Myung et al., 2009b). These conclusions are reinforced by studies that were completed since our review paper was published.

“we recommend that research on the topic of mobile phone use and health should not be funded by the industry because funding sources can influence research in subtle ways, and to preserve the credibility of the research it is important to avoid even the appearance of a conflict of interest.” (Myung et al, 2009b)

GAO Report:

“findings from a nationwide cohort study conducted in Denmark that originally followed 420,095 individuals did not show an association between increased risk for certain types of tumors, including cancerous tumors, and mobile phone use. Additionally, findings from a subset of the cohort—56,648 individuals with 10 or more years since their first mobile phone subscription—did not show an increased risk for brain and nervous system tumors. Further, these findings did not

change for individuals in the cohort with 13 or more years since their first mobile phone subscription. (GAO Report, pp.8-9)

Comment: In our review of the literature, we dismissed the results of the Danish Cohort study because we believed that serious methodologic problems rendered the results uninterpretable (Myung et al, 2009a). The study has been criticized because it was biased against finding increased tumor risk. Many of its results found what appeared to be reduced risk (i.e., a protective effect from using cell phones). That most of the heaviest cell phone users whose phones belonged to their businesses were classified as non-cell phone users biased the results against finding increased risk (Slesin, 2011).

"The Danish study has another, perhaps even more potentially fatal source of bias. The user population includes only those who had a cell phone in 1995—that was about 20% of the population. The Danish Cancer Society treats everyone who took up cell phones after 1995 as if they had never used one. They too are in the control group. That's hard to believe but true. Here's a direct quote from the BMJ paper: 'individuals with a subscription in 1996 or later were classified as non-users.'" (Slesin, 2011).

GAO Report:

"Also, the CEFALO study—an international case-control study that compared children aged 7 to 19 diagnosed with certain types of brain tumors, including brain cancers, to similar children who were not diagnosed with brain tumors—found no relationship between mobile phone use and risk for brain tumors." (GAO Report, p. 9)

Comment: Contrary to the study authors' conclusions and the GAO's summary, the CEFALO study reported significantly increased brain tumor risk among children who used cell phones in several analyses despite small amounts of cell phone use and short duration of use. See the Soderqvist et al (2011) for a full critique of this study and alternative interpretations of the results.

GAO Report:

"Findings from another study, which was conducted by NIH and examined trends in brain cancer incidence rates in the United States using national cancer registry data collected from 1992 to 2006, did not find an increase in new cases of brain cancer, despite a dramatic increase in mobile phone use during this time period." (GAO Report, p. 9)

Comment:

Although this study did not find an overall increase in brain cancer incidence, it did report an increase for young adults 20-29 years of age (Inskip et al., 2010). Young adults are likely to be more vulnerable to microwave radiation because their brains are not fully developed. The authors of the study dismissed this result because the tumors were located in the frontal lobe, and because the increased cancer incidence in men started before cell phones were popular in the U.S. However, absorption of microwave radiation is substantial in this lobe, and frontal lobe tumors have been associated with mobile phone use in case-control studies. Also, cordless phones which were popular before cell phones emit microwave radiation so these phones may have contributed to the increased tumor incidence observed in young adults.

GAO Report:

"Studies we reviewed suggested and experts we interviewed stated that laboratory research has not demonstrated adverse human health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have observed

effects on test subjects.... According to some studies we reviewed, while some of these studies have observed changes in behavior and cognitive function, overall, these studies have not consistently found adverse effects from RF energy levels emitted from mobile phones.” (GAO Report, p. 10)

Comment: Just as we found evidence for conflict of interest affecting the epidemiologic research, Dr. Henry Lai has reported possible evidence of conflict of interest with the toxicology research:

“Henry Lai, a research professor in the bioengineering department at the University of Washington, began laboratory radiation studies in 1980 and found that rats exposed to radiofrequency radiation had damaged brain DNA. He maintains a database that holds 400 scientific papers on possible biological effects of radiation from wireless communication. He found that 28 percent of studies with cellphone industry funding showed some sort of effect, while 67 percent of studies without such funding did so. “That’s not trivial,” he said.” (Randall Stross. Should you be snuggling with your cellphone? New York Times, Nov 13, 2010. URL: <http://www.nytimes.com/2010/11/14/business/14digi.html>)

An in-depth discussion of conflict of interest associated with research funding from the mobile phone industry and the U.S. Air Force can be found in Microwave News (Slesin, 2006).

GAO Report:

“Studies we reviewed and experts we interviewed identified key areas for additional epidemiological and laboratory studies, and according to experts, additional research may increase understanding of any possible effects. For example, additional epidemiological studies, particularly large long-term prospective cohort studies and case-control studies on children, could increase knowledge on potential risks of cancer from mobile phone use.” (GAO Report, p. 12)

Comment: In our review paper, we recommended long-term prospective cohort studies as this research could yield stronger empirical evidence than case-control study research (Myung et al., 2009a). However, we no longer recommend this for the following reasons: (1) Given the widespread adoption and use of cell phones it would be difficult to recruit enough individuals for the cohort who are not exposed to cell phone, cordless phone or Wi-Fi radiation, and variation over time in microwave radiation exposure levels are necessary to detect effects on tumor risk; (2) the research would be very costly and difficult to conduct as extremely large samples of participants would be needed due to the low incidence of brain tumors; and (3) the results would not be available for 20-30 years since the latency between exposure to cell phone radiation and tumor detection can be up to four decades; meanwhile, cell phone technology keeps changing so the results may have limited value when they are published.

GAO Report:

“additional studies on laboratory animals as well as human and animal cells examining the possible toxic or harmful effects of RF energy exposure could increase knowledge on potential biological and health effects of RF energy. Further, additional laboratory studies on human and animal cells to examine non-thermal effects of RF energy could increase knowledge of how, if at all, RF energy interacts with biological systems. However, some experts we spoke to noted that, absent clear evidence for adverse health effects, it is difficult to justify investing significant resources in research examining non-thermal effects of RF energy from mobile phone use.” (GAO Report, p. 12)

Comment: Although results are not consistent, numerous peer-reviewed toxicology studies demonstrate evidence for non-thermal effects of RF energy from mobile phone use, especially for GSM and UMTS mobile phone carrier systems (Juutilainen et al., 2011; Wolchover, 2011). Fewer studies have been conducted on CDMA and W-CDMA mobile carrier systems, and there is less evidence for biologic activity for these technologies. The lack of research on CDMA and W-CDMA can be explained by two factors: (1)

Most research on the health effects of cell phone radiation has been conducted outside of the U.S. because our federal government has neglected to fund this research with minor exceptions; and (2) few countries other than the U.S. employ CDMA and W-CDMA (currently used by half of the U.S. population who have Verizon and Sprint as their cell phone providers); hence, few countries fund research on these two technologies.

The U.S. has one major study in progress that contrasts the effects of GSM and CDMA in mice and rats conducted by the National Toxicology Program. Results from this study should be available by 2015. However, these 2G (second generation) technologies are likely to be obsolete in the U.S. by 2016. We need a major research funding initiative now to evaluate the effects of 3G (UMTS, W-CDMA) and 4G (LTE, WiMax) technologies and to enable us to set appropriate regulatory standards for these forms of microwave radiation to protect population health.

GAO Report:

"The Danish National Birth Cohort consists of over 100,000 Danish children who were born from 1996 to 2002. Data on lifestyle factors, dietary habits, and environmental exposures have been collected on these children, and data on current mobile phone use by children have been collected since these children reached the age of seven." (GAO Report, Footnote b, p. 14)

Comment: The only mention of this study in the Report appears in a footnote even though Dr. Leeka Kheifets at UCLA was one of the experts the GAO consulted. Moreover, her study is one of a few cell phone radiation health effect studies that the federal government has funded. Dr. Kheifets has published two peer-reviewed papers that reported behavioral problems in children exposed *in utero* to cell phone radiation (Divan et al., 2008, 2012). These children were more likely to display symptoms that resemble attention deficit disorder. If these reproductive health effects are replicable, they have profound implications for public health. Recently, Dr. Hugh Taylor at Yale replicated these behavioral effects in an experimental study conducted with rats exposed to cell phone radiation *in utero* (Aldad et al., 2012).

GAO Report:

"In 1996, FCC adopted the RF energy exposure limit for mobile phones of 1.6 watts per kilogram, averaged over one gram of tissue, a measurement of the amount of RF energy absorbed into the body.²⁸ FCC developed its limit based on input from federal health and safety agencies as well as the 1991 recommendation by the Institute of Electrical and Electronics Engineers (IEEE) that was subsequently approved and issued in 1992 by the American National Standards Institute (ANSI). This recommended limit was based on evidence related to the thermal effects—the only proven health effects of RF energy exposure—and was set at a level well below the threshold for such effects. FCC noted that the limit provided a proper balance between protecting the public from exposure to potentially harmful RF energy and allowing industry to provide telecommunications services to the public in the most efficient and practical manner possible." (GAO Report, pp. 16-17)

Comment: In 1996, the FCC based its cell phone radiation standard on a set of recommendations made by two industry groups composed largely of engineers. The exposure limit protects the user from the acute effects from heating of body tissue but not from the non-thermal effects of microwave radiation. The FCC claimed that the SAR limit it adopted was based on input from federal health and safety agencies yet it ignored the EPA's recommendation at the time that the SAR be limited to 1.0 watts per kilogram instead of 1.6 watts per kilogram. Instead, the FCC traded public safety for the industry's recommendation to achieve what it considered "a proper balance."

"The EPA and NIOSH, two health agencies that have studied the RF/MW health data for decades, have each advocated pegging the threshold to 1 W/Kg for the public and to 2 W/Kg for workers, respectively." (Slesin, 19966)

GAO Report:

"FCC has implemented standardized testing procedures requiring mobile phones to be tested for compliance with the RF energy exposure limit when in use against the ear and against the body while in body-worn accessories, such as holsters, but these requirements may not identify the maximum exposure under other conditions. The specific minimum separation distance from the body is determined by the manufacturer (never to exceed 2.5 centimeters), based on the way in which the mobile phone is designed to be used. FCC has not reassessed its testing requirements to ensure that testing identifies the maximum RF energy exposure for the other usage conditions a user could experience when mobile phones are in use without body-worn accessories or as advised by the manufacturer's instructions, rather than the head." (GAO Report, pp. 22-23)

Comment: The FCC should not have allowed manufacturers the latitude to decide whether to test the phone from 1.5 to 2.5 centimeters from the body in the "against the body" test. Because these distances are in the "near-field" of the antenna each additional millimeter corresponds to a 15% reduction in emissions. A phone tested at 2.5 cm can produce up to 5 times the microwave radiation as a phone tested at 1.5 cm and still be legal. Furthermore, the "against the body" SARs are not comparable for two phones tested at different distances from the body.

According to the FCC 2001 guidelines, the manufacturer can use warning labels to ensure that the user maintains a minimum distance between his body and the phone that corresponds to the distance used in the SAR test procedure. However, if the manufacturer, cannot ensure that the user will comply with this instruction, then the SAR test must be conducted "at its closest range to persons under normal operating conditions."

"When applicable, operation instructions and prominent warning labels may be used to alert the exposed persons to maintain a specified distance from the transmitter or to limit their exposure durations and usage conditions to ensure compliance. If the use of warning labels on a transmitter is not effective or desirable, the alternative of performing SAR evaluation with the device at its closest range to persons under normal operating conditions may be used." (FCC, 2001, p. 8)

GAO Report:

"Representatives from some consumer groups and experts we spoke with raised concerns that the information on federal agency websites about mobile phone health effects is not precautionary enough, among other things. In particular, these representatives and experts said that federal agencies should include stronger precautionary information about mobile phones because of the uncertain state of scientific research on mobile phone health effects as well as the fact that current testing requirements may not identify the maximum possible RF energy exposure." (GAO Report, p. 25)

Comment: Information on federal agency websites about mobile phones is at best confusing, and often misleading. Coverage of the health effects research has often been biased. For example, news coverage of the major Interphone Study paper reported "no evidence" of increased tumor risk on both the FDA and the NCI web sites (e.g., "No Evidence Linking Cell Phone Use to Risk of Brain Tumors," FDA Consumer Health Information; May 17, 2010). This was completely false as a significant 40% increased glioma risk was found for the heaviest cell phone users (which corresponded to about 30 minutes per day over 10 years) (Interphone Study Group, 2010a). Appendix 2 of this paper presented results from analyses that corrected for selection bias in the study (Interphone Study Group, 2010b). In the appendix, the heaviest cell phone users had 82% increased risk of glioma as compared to those who used cell phones less than 5 hours in their lifetime. Moreover, a significant dose-response relationship for number of years of cell phone use and glioma risk was reported. Based upon the results of this study, two of the investigators including the lead investigator have called for precautionary health warnings to "reduce exposure to the brain from mobile phones...particularly among young people" (Cardis and Sadetzki, 2011).

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Cell Phone Radiation Science Review on Cancer Risks and Children's Health





Cell Phone Radiation

Science Review on Cancer Risks and Children's Health

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Cell Phone Radiation Science Review

Executive Summary

More than 4 billion people around the world use cell phones (ITU 2009). Because cell phone technology has been around for just two decades, scientists do not yet fully understand long-term health risks from cell phone radiation. But recent research has prompted serious concerns about exposure to wireless emissions.

Prior to 2003, studies of cancer risk and cell phone use produced conflicting results. FDA told consumers that scientists had found no harmful health effects from exposure to cell phone emissions. (FDA 2003).

But FDA's assurances were based on studies of people who had used cell phones for just 3 years, on an average (FDA 2003), not long enough to develop cancer. At that time, studies had not addressed the risks of longer-term exposures.

The research gap is closing. Scientists around the world have recently associated serious health problems with using cell phones for 10 years or longer:

- A joint study by researchers in Denmark, Finland, Norway, Sweden and the United Kingdom found that people who had used cell phones for more than 10 years had a significantly increased risk of developing glioma, a usually malignant brain tumor, on the side of the head they had favored for cell phone conversations (International Agency for Research on Cancer (IARC) 2008; Lahkola 2007).
- French and German scientists reported an increased risk of glioma for long-term cell phone users (Hours 2007; Schuz, Bohler, Berg 2006). Analysis of all published cell phone-brain tumor studies found that people who had used a cell phone for 10 or more years, the overall risk for developing a glioma on the cell phone side of the head increased by 90 percent (Hardell 2009; Kundi 2009).
- Cell phone use for 10 years and longer has been also associated with significantly increased risk of acoustic neuroma, a type of benign brain tumor, on the primary side of cell phone use (IARC 2008; Schoemaker 2005). An extensive review of published studies of acoustic neuroma found that long-term cell phone users had a 60 percent greater risk of being diagnosed with the disease (Hardell 2009; Kundi 2009).
- A study from Israel reported an association between frequent and prolonged mobile phone use and parotid (salivary) gland tumors (Sadetzki 2008). Scientists analyzing data from Sweden and Denmark combined found that people who had used cell phones for at least 10 years ran an increased risk of benign parotid gland tumors (IARC 2008; Lonn 2006).
- Multiple studies reported that the brains of young children absorb more radiation than those of adults (de Salles 2006; Gandhi 1996; Kang 2002; Martinez-Burdalo 2004; Wang 2003; Wiart 2008), potentially rendering them more vulnerable to brain tumors (NRC 2008b). Researchers in Sweden found the highest risk of brain tumors among people who started using cell phones during adolescence (Hardell 2009).

Recent studies link cell phone radiation to:

Brain cancer: Two analyses of 25 original publications identified a 50 to 90 percent increase in risk for two types of brain tumors: glioma and acoustic neuroma (Hardell 2009, Kundi 2009).

Salivary gland tumors: An Israeli study found an increased risk of 50 to 60 percent for salivary gland tumors among people with highest cell phone use (Sadetzki 2008).

Behavioral problems: A study of 13,159 Danish children showed 80 percent elevated risk for emotional and hyperactivity problems among young children who use cell phones and whose mothers also used cell phones during pregnancy (Divan 2008).

Migraines and vertigo: A study of 420,095 Danish adults showed that long-term cell phone users were 10 to 20 percent more likely to be hospitalized for migraines and vertigo than people who took up cell phones more recently. (Schuz 2009).

Scientists have known for decades that high doses of the radiofrequency radiation emitted by cell phones can penetrate the body, heat tissues, trigger behavioral problems and damage sensitive tissues like the eyeball and testicle (Heynick 2003; IEEE 2006).

Yet when cell phones went on the market in the 1980s, federal regulators did not require manufacturers to prove they were safe (GAO 1994).

Recent studies raise particular concerns about the impact of cell phone emissions on children. The National Research Council (NRC) has observed that "with the rapid advances in technologies and communications utilizing [radiation in the range of cell phone frequencies], children are increasingly exposed... at earlier ages (starting at age 6 or before)" (NRC 2008b). The NRC called for "investigation of the potential effects of RF fields in the development of childhood brain tumor" (NRC 2008b).

- Research by France Telecom scientists showed that under standard conditions of use, twice as much cell phone radiation would penetrate a child's thinner, softer skull than an adult's (Wiat 2008). These results confirm earlier findings that children's heads absorb more radiofrequency radiation than adults (Gandhi 1996; Kang 2002; Wang 2003).
- Children will be exposed to cell phone radiation for more years and therefore in greater total amounts than the current generation of adults (NRC 2008b).

Few research studies have focused on the health hazards of children's cell phone use, even though the youth market is growing. But one recent study of 13,159 Danish children showed that young children who use cell phones and whose mothers also used cell phones during pregnancy are 80 percent more likely to suffer emotional and hyperactivity problems (Divan 2008).

In response to the growing debate over the safety of cell phone emissions, government agencies in Germany, Switzerland, Israel, United Kingdom, France, and Finland and the European Parliament have recommended actions to help consumers reduce exposures to cell phone radiation, especially for young children.

In contrast, the two U.S. federal agencies that regulate cell phones, the Food and Drug Administration (FDA) and the Federal Communication Commission (FCC), have all but ignored evidence that long term cell phone use may be risky.

Government actions: radiation standards and public education

Health agencies in six nations — Switzerland, Germany, Israel, France, United Kingdom, and Finland — have recommended reducing children's exposures to cell phone radiation.

In 2008, the European Parliament passed a resolution urging member countries to develop lower radiation emission limits for cell phones. Legislation introduced in the French Senate would ban marketing and sales of phones for children under age 6.

Brussels, Belgium; Salzburg, Austria; and Christchurch, New Zealand have proposed strict local cell phone radiation standards. Toronto has issued guidance to parents on reducing children's cell phone use.

The FCC adopted radiation standards developed by the cell phone industry 17 years ago. These standards, still in use, allow 20 times more radiation to reach the head than the rest of the body. They do not account for risks to children.

While compiling a database of radiation emitted by more than 1,000 cell phones sold in the U.S., the Environmental Working Group has found that emissions can vary by a factor of up to 8 from one phone to another.

The cell phone industry has reported 270 million wireless subscriptions by the end of 2008, equivalent to 87 percent of the U.S. population (CTIA 2009, ITU 2009). This number is only expected to grow. Consumers need — at a minimum — easy access to cell phone radiation information so that they can make informed purchasing decisions and protect themselves and their families from potential health concerns.

Studies: Cell phone radiation may cause tissue damage

Cell phones communicate via electromagnetic waves. During signal transmission, a comparable amount of radiation travels outward, towards the base station, and inward, towards the ear or head of the cell phone user. (IEGMP 2000).

Cell phone waves are in the “radiofrequency” range. They lack the penetrating energy of X-rays and radioactivity. Scientists are still exploring how cell phone radiation may cause the harmful effects that some studies have described.

Scientific research conducted over the past decade has associated cell phone radiation with increased risk of developing brain and salivary gland tumors, neurological symptoms such as migraine and vertigo, and neurodevelopmental effects observed as behavioral problems in young children (BioInitiative 2007; Divan 2008; Kundi 2009; Sadetzki 2008; Schuz 2009).

Cell phones, radios and TV transmissions emit non-ionizing radiation that has a longer wavelength, lower frequency and lower overall energy per photon than UV light, X-rays and gamma rays (a form of radioactivity), which are known as ionizing radiation because they have enough power to eject an electron from its orbit and leave behind a charged ion that can damage cells and tissues.

The National Research Council has reported that exposure to cell phone radiation may affect the immune, endocrine and nervous systems, fetal development and overall metabolism (NRC 2008b). Children are likely to be more susceptible than adults to effects from cell phone radiation, since the brain of a child is still developing and its nervous tissues absorb a greater portion of incoming radiation compared to that of an adult (Gandhi 1996; Kang 2002; Kheifets 2005; Schuz 2005; Wang 2003; Wiart 2008).

FCC industry radiation standards have little margin of safety

The FCC’s cell phone radiation standards closely follow the recommendations of the Institute of Electrical and Electronics Engineers (IEEE) (FCC 1997). These standards allow 20 times more radiation to penetrate the head than the rest of the body and do not account for risks to children.

FCC standards limit the radiation absorbed by a cell phone user’s brain and body to a specific absorption rate, or SAR, measured by the amount of the phone’s radiation energy (in watts, W) absorbed per kilogram of tissue (W/kg).

Current FCC regulations permit SAR levels of up to 1.6 W/kg for partial body (head) exposure, 0.08 W/kg for whole-body exposure, and 4 W/kg for exposure to the hands, wrists, feet and ankles (FCC 1997, 1999).

The FCC standards are based on animal studies conducted in late 1970s and early 1980s (Osepchuk 2003). FCC, on the recommendation of the IEEE, adopted SAR level of 4 W/kg as the point of departure for determining legal SAR limits for cell phones. In contrast to the FCC decision, an independent analysis by the EPA scientists concluded, on the basis of the same body of data, that biological effects occur at SAR levels of 1 W/kg, 4 times lower than the SAR level chosen by IEEE (U.S. EPA 1984). Exposure to radiofrequency radiation at these SAR levels induces tissue heating that leads to behavioral alterations in mice, rats, and monkeys, that may be a “potentially adverse effect in human beings” (IEEE 2006).

Current FCC standards fail to provide an adequate margin of safety for cell phone radiation exposure and lack a meaningful biological basis.

For example, the FCC standard for the head is just 2.5 times lower than the level that caused behavioral changes in animals. The standard that applies to hands, wrists, feet, and ankles has no safety margin whatsoever.

The FCC adopted IEEE’s proposal to allow 20 times more radiation to the head than the average amount allowed for the whole body, even though the brain may well be one of the most sensitive parts of human body with respect to radiofrequency radiation and should have more protection.

To receive the FCC approval for selling a cell phone in the U.S. market, manufacturers typically conduct the phone’s SAR tests themselves or contract with the private industry. Private industry organizations (Telecommunication Certification Bodies) are also actively involved in all steps of determining the compliance of cell phones and other wireless devices with the FCC rules (FCC OET 2008f).

SAR testing of cell phones is carried out on a mold in the shape of an adult torso or head which is filled with a viscous fluid mixture selected to simulate the electrical properties of human tissue (GAO 2001). To determine SAR, a cell phone is placed next to the outer surface of the mold and turned on to transmit at the maximum power while a probe is inserted into the viscous inner mixture at various locations, measuring the radiofrequency energy that is being absorbed (GAO 2001).

FCC, the cell phone industry, and the academic community all acknowledge that SAR measurements have significant precision problems (Cardis 2008; FCC OET 2008e; GAO 2001; Wiart 2008). Studies by scientists in academia and the cell phone industry demonstrate that SAR is significantly influenced by the age, shape of the head, and tissue composition (Conil 2008; Wang 2003; Wiart 2008).

The greatest debate is whether the current methods for SAR measurement is adequate for assessing radiation absorption in children's brains (Gandhi 1996; Wang 2003). Recent research on SAR in test models for children's brains and bodies indicates that SAR levels in children would be much higher than in adults (Conil 2008; de Salles 2006; Gandhi 1996; Martinez-Burdalo 2004; Wang 2003; Wiart 2008).

Cell phone standards ignore children

Scientists in a number of countries agree that the head and brain of a child absorb significantly more radiation than those of an adult (de Salles 2006; Gandhi 1996; Kang 2002; Wang 2003; Wiart 2008). Yet U.S. cell phone emission levels and federal standards are based on radiation absorbed by adults and fail to account for children's higher exposures and greater health risks.

In general, as head size decreases, the percentage of energy absorbed by the brain increases, (Martinez-Burdalo 2004). Moreover, children's tissues have higher water and ion content compared to adult tissues (Peyman 2009). Both factors increase radiation absorption, according to researchers from the U.S., the Finnish cell phone company Nokia, Institute of Applied Physics in Spain and the U.K. Health Protection Agency (Gandhi 2002; Keshvari 2006; Martinez-Burdalo 2004; Peyman 2009).

All these data, taken together, suggest that when a child uses a cell phone that complies with the FCC standards, he or she could easily absorb an amount of radiation over the maximum allowed radiation limits defined by the federal guidelines. FCC standards give adults only a slim margin of safety over emission levels that harm animals. For children, the margin is much slimmer – if one exists at all.

Consumers have a right to full information on cell phone radiation levels

Cell phone manufacturers opposed SAR disclosure (Lin 2000) until 2000, when the FCC began posting cell phone SAR values on its web site. After the FCC decision, the Cellular Telecommunications Industry Association (CTIA) began requiring manufacturers to disclose cell phone SARs.

According to CTIA guidelines, a mobile phone SAR value must be listed in the user manual or on a separate sheet. The trade association does not require listing the SAR value on the box or the phone itself (Microwave News 2000).

Cell phone radiation levels are rarely available at retail locations. Consequently, consumers cannot easily identify low-radiation phones.

FCC maintains a database of mobile phone SAR values for devices currently on the market, but it is difficult to use. With significant effort, a consumer can navigate the FCC website to find the SAR value for a specific phone.

To search the FCC database, the consumer needs the mobile phone's FCC ID number, located on a sticker underneath the phone's battery. The first three characters of the FCC ID is the Grantee Code; the remaining numbers and letters of the ID are a product code that can be entered into the online FCC ID Search Form (<http://www.fcc.gov/oet/ea/fccid>), to pull up five to seven data entries. Consumers must scroll manually through each of the data entries to locate the document that lists the SAR value for the specific mobile phone.

In contrast to this cumbersome process, the German Federal Office for Radiation Protection (BfS) maintains a detailed, open directory of information on mobile phones available in the German market (BfS 2008b). Such a publicly available database greatly facilitates consumers' access to SAR data, enables informed purchasing decisions and encourages phone manufacturers to offer lower-SAR phones.

Recommendations

The U.S. government should require phones to be labeled with their radiation emissions at the point of sale, so consumers can make informed decisions about the phones they buy.

The cell phone industry should offer consumers phones that operate with the least possible radiation, and should make each phone's radiation emissions available at the point of sale.

Cell phone users can protect themselves and their families by buying low-radiation phones. Look for currently available low-radiation options in the EWG's cell phone radiation buyer's search tool that lists radiation output of more than 1,000 cell phones.

Cell phone users can also reduce exposures by using their phone in speaker mode or with a headset.

And please help us tell the government to update its cell phone standards.

Cell Phone Radiation Science Review

Section 1: Do cell phones cause cancer or other illnesses?

Research on cancer risk in cell phone users

Researchers and public health experts worldwide actively debate if cell phone radiation can lead to brain cancer (American Cancer Society 2008; FDA 2003; Hardell 2009; IARC 2008, 2009b; Kundi 2009). While earlier, short-term studies did not find an increased risk of brain cancer (Ahlbom 2009; Croft 2008; FDA 2003), long-term data published over the last four years found an increased risk of developing two types of brain tumors on the ipsilateral side (the side of the brain on which the cell phone is primarily held) among people who used a cell phone for longer than 10 years (Hardell, Carlberg 2006b; Hours 2007; Lahkola 2007; Lonn 2005; Schoemaker 2005; Schuz, Bohler, Berg 2006; Takebayashi 2008):

- Glioma – a typically malignant tumor of the brain that arises from glial cells that provide physical support for the central nervous system;
- Acoustic neuroma – a benign tumor of the vestibulocochlear nerve that innervates the ear.

Two recent studies also reported increased risk of salivary gland (parotid gland) tumors among cell phone users (Lonn 2006; Sadetzki 2008).

In the late 1990s, the International Agency for Research on Cancer (IARC) developed a multinational case-control study, INTERPHONE, to address strong public concerns about cell phone safety (Cardis 1999). The goal of the INTERPHONE study was to investigate whether the radiofrequency radiation emitted by cell phones is carcinogenic (IARC 2009b). Thirteen countries participated in the project (Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden and the UK). The study ran from 2000 to 2006, cost 30 million U.S. dollars (Economist 2008) and involved 14,078 study participants, among them 2,765 glioma, 2,425 meningioma, 1,121 acoustic neurinoma, 109 malignant parotid gland tumour cases and 7,658 controls (Cardis 2007).

The publication of final results and conclusions of the entire INTERPHONE study has been delayed for three years since the conclusion of the study (IARC 2009a; Microwave News 2009). Scientists have questioned whether the study design methods were adequate for detecting increased cancer risk, and whether recall biases might have impacted the quality of the data and resultant conclusions (Cardis 2007; Kundi 2009; Vrijheid, Armstrong 2009; Vrijheid, Cardis 2006; Vrijheid, Deltour 2006; Vrijheid, Richardson 2009). Meanwhile, scientists from different international centers have begun to publish their findings independently (Cardis 2007; Lonn 2005; Schlehofer 2007; Schoemaker 2005; Schuz, Bohler, Schlehofer 2006; Takebayashi 2006).

As described in the article published by the Economist in September 2008:

“Delays in releasing the report have been due to “the difficulty of interpreting the findings due to potential biases” and to the “conducting of additional analyses to try and disentangle the potential impacts of selection and recall errors on the risk estimates”. The Interphone researchers are split into three camps. One believes any increased incidence of tumours shown in the study is purely the result of the biases. Another thinks it really has found increased risks of certain tumours and wants to call for precautionary measures. A third group is just keeping quiet. One person who knows many of the scientists, but prefers not to be named, describes the relations between members of the three groups as “strained”—harsh language in the world of scientific research.” (Economist 2008)

The latest update of the INTERPHONE study results, published on October 8, 2008 (IARC 2008), included 6 publications that found some increase in the risk of glioma for long-term cell phone users, especially on the ipsilateral side (Christensen 2005; Hours 2007; Lahkola 2007; Lonn 2005; Schuz, Bohler, Berg 2006). This side of the head absorbs 97-99% of the total electromagnetic energy deposited in the brain during calls (Cardis 2008), which supports the link between cell phone use and ipsilateral brain tumor development. Only two of the INTERPHONE studies did not find an increased glioma risk (Hepworth 2006; Takebayashi 2008). Increased risk

of glioma associated with long-term cell phone use has been also reported by the Hardell group in Sweden (Hardell, Carlberg 2006b; Hardell 2009).

INTERPHONE results for acoustic neuroma are more varied. Of the 7 INTERPHONE reports on acoustic neuroma, 5 publications based on less than 10 years exposure did not detect an increased risk (Christensen 2004; Hours 2007; Klaeboe 2007; Schlehofer 2007; Takebayashi 2006). In contrast, two publications that were based on longer than 10-year exposure reported an increased risk of acoustic neuroma (Lonn, Ahlbom 2004; Schoemaker 2005). Similar to glioma, the risk for developing acoustic neuroma appears to be strongest for tumors on the ipsilateral side and long-term exposures (Hardell, Carlberg 2006a; IARC 2008).

A meta-analysis that combined results from all brain tumor studies published to date reported that among people who had used cell phones for more than 10 years, the risk of ipsilateral brain tumor increased by 90% for glioma and 60% for acoustic neuroma (Hardell 2009; Kundi 2009). Some studies have also reported an increased risk of the benign brain tumor meningioma, although the risk appears to be smaller and thus much harder to detect (Hardell 2009; Kundi 2009; Takebayashi 2008). Authors of the study noted that the risk appears to be higher in rural areas where phones typically radiate at higher intensities to allow signals to reach distant transmission towers (Hillert 2006).

While the publication of the final INTERPHONE summary is pending (IARC 2009a), detailed post-study analysis suggested that some of the negative findings may have been related to the study design and methods for determining past personal patterns of cell phone use (Hardell and Hansson Mild 2006; IARC 2008; Vrijheid, Cardis 2006; Vrijheid, Deltour 2006; Vrijheid, Mann 2009; Vrijheid, Richardson 2009). For example, among studies where the observed effects were weak, an increased risk of brain tumor was nevertheless reported for long-term users, users with the largest number of calls, and users with the largest numbers of telephones (Hours 2007; Schoemaker 2009).

Recently, a large-scale, multi-center study in Israel also found an association between salivary (parotid) gland cancer and heavy use of cell phones, especially for rural areas where cell phones typically transmit at higher power (Sadetzki 2008). As reported by the team of Israeli scientists, the anatomic location of the parotid gland just below the ear would make it vulnerable to cell phone radiation exposure. Parotid tumor occurs at a relatively young age (43-55 years of age), so that many current cell phone users may already be at risk for these tumors (Sadetzki 2008).

Researchers found a 48-58% increased risk of salivary gland tumors among people who make the greatest total number of calls or who log the most time on the phone without a hands-free device compared to others in the study group, on the side of the brain on which the cell phone was held (ipsilateral). No increased risk was seen for tumors on the other side of the head (Sadetzki 2008). The Israeli findings are in close agreement with an earlier study conducted in Sweden and Denmark; this study, based on a cohort about 1/3rd the size of the Israeli cohort, observed a 40% increased risk of ipsilateral benign tumors (Lonn 2006).

The fact that scientists have measured increased tumor risk in so many studies of cell phone users is even more powerful given that people have used cell phones widely for only about a decade, while cancer typically requires 15-20 years to develop. It seems likely that studies conducted in future years may find more consistent and higher cancer risks (Ahlbom 2004; Ahlbom 2009; Krewski 2001; Krewski 2007; Kundi 2009; Kundi 2004).

Strikingly, the field of research on the health effects of cell phone use has exhibited the signature pattern of a so-called "funding effect," a biased outcome due to source of funding, observed in studies funded by tobacco companies or the manufacturers of industrial chemicals such as the endocrine disrupting plasticizer BPA (vom Saal 2005). In 2001, the U.S. Government Accountability Office voiced a strong concern about the reliability of results from industry-funded studies conducted without government oversight (GAO 2001). A recent systematic review of the source of funding and results of studies of health effects of cell phone use indicated that studies funded by the cell phone industry were ten times more likely to report no adverse effects compared to studies funded by public agencies or charities (Huss 2007; Huss 2008). Thus, some of the heterogeneity in the earlier literature could be related to the source of funding, whereby research sponsors could influence the design of the study, the nature of the exposure, and the type of outcome assessed.

Cell phones and health effects other than cancer

New lines of research are examining central nervous system diseases other than brain tumors in relation to cell phone use:

- A recent Danish study noted an increased risk for neurological symptoms such as migraine and vertigo for cell phone users (Schuz 2009);
- Scientists have found an increased risk for Alzheimer disease associated with electromagnetic radiation (Huss 2009);
- A study from the University of California, Los Angeles found a correlation between prenatal exposure to cell phone radiation and behavioral problems in children (Divan 2008).
- Six studies from the U.S., Australia, Japan and Europe reported that exposure to cell phone radiation has an adverse effect on sperm counts, motility and vitality (Agarwal 2009; De Iuliis 2009; Eroglu 2006; Fejes 2005; Salama 2009; Yan 2007).

In animal studies, scientists have found that exposure during gestation to radiofrequency radiation like that emitted by cell phones is associated with decreased fetal growth, developmental abnormalities, and death of offspring (BioInitiative 2007; Heynick 2003). In occupational health studies for female physiotherapists, conducted in Sweden, Israel, and Finland, scientists found that workplace exposure to radiofrequency radiation during pregnancy is associated with low birth weight, congenital malformations, fetal death, and spontaneous abortions (Kallen 1982; Lerman 2001; Taskinen 1990).

The key question in the cell phone research field is how radiofrequency radiation like that from cell phones affects biological tissues and cells. Scientists have proposed and explored a number of possible mechanisms:

- A number of studies examined the potential for genotoxicity of electromagnetic fields (harm to genetic material in body cells that can lead to mutations and cancer) (BioInitiative 2007; Phillips 2009). While the evidence is not yet conclusive, one quarter of studies published on this issue found a genotoxic effect from low-level exposures (Vijayalaxmi 2008).
- Scientists have reported that cell phone radiation affects levels of reactive oxygen species (ROS) inside the cell (Irmak 2002; Zmyslony 2004). In turn, higher ROS levels trigger intracellular signaling cascades that interrupt the smooth functioning of the cell. Changes in the activation status of molecules within these signaling cascades can lead to inflammation, heart disease, cancer and other chronic health conditions (Boutros 2008; Muslin 2008; Skaper 2007).
- Cell phone radiation-induced reactive oxygen species may well be the causative agent that induces DNA damage, which is a precursor to cancer (Phillips 2009) and a potential mechanism of toxicity to sperm cells (De Iuliis 2009).
- Radiofrequency radiation has been associated with a change in the activity of white blood cells (Aly 2008).
- Exposure to cell phone radiation has been associated with cell death and activation of intracellular signaling molecules (Lee 2008). There is a vigorous debate in the literature regarding the types of conditions under which radiofrequency radiation would cause cell death (Guney 2007; Nikolova 2005; Palumbo 2008; Zhao 2007).

As described in a recent expert review, "In a living cell, many important processes occur by electron transfer across membrane structures in a well-organized manner, ions cross selective channels, proteins get activated and deactivated by cascades of precisely regulated enzymes" (Kundi 2009). These electronic processes would likely be affected by the electromagnetic fields, leading to altered cellular function, growth, and differentiation (Karinen 2008; Moisesescu 2008; Zareen 2009). While none of these processes individually can be considered equivalent to the development of disease, all of them are associated with chronic adverse health effects and need to be considered in the assessment of radiofrequency radiation impact on biological organisms.

Cell Phone Radiation Science Review

Section 2: Cell Phone Safety Standards

Radiofrequency radiation associated with cell phones

FCC established the first radiation standards for cell phones in 1996, 13 years after cell phones were first marketed in the U.S. The agency adopted limits recommended by industry (IEEE C95.1-1991) that were established to protect against high-dose thermal effects, that allow a 20-fold higher exposure to the head (1.6 W/kg) compared to the rest of the body (0.08 W/kg), and that do not account for a child's higher exposure and greater vulnerability to cell phone radiation.

In the U.S., cell phones operate at electromagnetic wave frequency of either 800-900 megahertz (MHz) or 1800-1900 MHz. This frequency range is called radiofrequency (RF), since radios and TVs operate in the same portion of electromagnetic spectrum. The power density or intensity of transmitted electromagnetic field (EMF) is measured in watts (W) per m² or, more commonly, milliwatts per cm² (mW/cm²).

Cell phone radiation is transmitted by the antenna and the circuit elements inside the handset. The antenna and the circuit elements send out the electromagnetic wave (RF radiation) to transmit the signal. The inner antenna is usually a metal helix or a metal rod a few centimeters long that is able to transmit RF radiation of sufficient power so as to deliver the signal from the handset to the base station. The antenna is typically located on the back of a cell phone or a wireless device. The power at which a cell phone must transmit to reach a base terrestrial station is affected by many factors, such as frequency (900 or 1800 MHz), the phone distance from the base station, and physical obstacles between the phone and the base station. To overcome obstacles and interference, a cell phone transmits at greater power. This power is controlled from the base station.

In a rural area with sparse locations of cell phone towers, cell phones need to transmit signal at a greater power (Hillert 2006). A study in Sweden demonstrated that in the rural area, the highest power level was used about 50% of the time, while the lowest power was used only 3% of the time. The corresponding numbers for the city area were approximately 25% and 22% (Lonn, Forssen 2004). In agreement with these data, rural users of cell phones appear to be at a higher tumor risk compared to urban users, likely due to higher power radiation emitted by a phone when located further away from a base station (Hardell 2005; Sadetzki 2008).

EMF radiation emitted by a cell phone antenna is not very directional – similar amounts of radiation are transmitted outward, towards the base station, and inward, towards the ear/head of a cell phone user where they readily penetrate into the body and are absorbed into the inner tissues (Independent Expert Group on Mobile Phones (IEGMP) 2000). Of note, it is possible to design directional antennas so as to decrease radiation exposure to the cell phone user (Wireless Galaxy 2009). Multiple factors influence how much radiation goes into the head, including: the type of digital signal coding in the network, such as GSM (Global System for Mobile Communication), CDMA (Code division multiple access) or UMTS (Universal Mobile Telecommunication System); the antenna design; location of the antenna relative to the head; and the position of the hand or use of an earpiece (Swiss Federal Office of Public Health 2009c).

Of the total radiation emitted towards the head, most (97–99%, depending on frequency and cell phone network) is absorbed in the brain hemisphere on the side where the phone is used (Cardis 2008). The temporal lobe, an area of the brain involved in auditory processing, formation of long-term memory, as well as some aspects of speech and vision, receives the highest radiation exposure (Cardis 2008). Additionally, when a phone is worn near the waist during its use (as may occur when a corded or a cordless headset is used), much of the outgoing radiation is absorbed by adjacent soft tissues, which may pose health risks (Agarwal 2009; Swiss Federal Office of Public Health 2009c; Whittow 2008).

Absorption of radiofrequency energy involves interaction with polar molecules or ions inside the cells and in extracellular fluids such as cerebrospinal fluid, leading to readily detectable temperature elevation in organs and tissues (ICNIRP 1998; IEEE 2006). The heat generated in tissues absorbing RF energy can cause thermal effects that range from behavioral problems to damage to sensitive tissues like the eyeball or testicle. Researchers have

also suggested non-thermal mechanisms of action for some of the effects seen in studies, including effects on ion channels within a cell, effects on membrane enzymes, creation of membrane pores, and free radical formation; scientists worldwide are actively investigating these possible effects of cell phone radiation (NRC 2008b; Weaver 2006).

Specific absorption rate (SAR) for the cell phone radiation

Biological effects caused by radiofrequency radiation depend on the rate at which the energy is absorbed by a particular mass of tissue, calculated as specific absorption rate, or SAR, and measured in watts per kilogram (W/kg). Since brain structures on the side where a cell phone is used (the ipsilateral side) receive significantly higher dose of radiation, and since radiation is unevenly absorbed into different types of tissues (bone, cartilage, nervous tissue, or distinct anatomical structures within the brain), international experts agree that more precise SAR measurements can be obtained when averaging over a smaller volume of tissue (Cardis 2008).

In general, energy absorption rate increases with greater conductivity of tissue and decreases with greater tissue density. Absorption rate is also directly proportional to the intensity of the electromagnetic field (its power density). To carry out an SAR test, a mold in the shape of human torso or head is filled with a fluid designed to simulate the electrical properties of human tissue. Typically, a head model is filled with a thick, viscous mixture that is meant to simulate the conductivity of head tissues; the mixture includes water, salt, sugar, and a chemical viscosity additive. During testing the phone is placed next to the outer surface of the mold and made to transmit a signal at full power while an inner probe is moved through the fluid mixture, measuring the radiofrequency energy that is being absorbed at various locations (IEC 2005). The certified SAR level of a given phone is supposed to be the highest SAR value measured during those tests.

FCC, the industry, and the academic community all acknowledge that SAR measurements have significant precision problems (Cardis 2008; Conil 2008; FCC OET 2008e; GAO 2001; Wiart 2008). Studies by scientists in academia and the cell phone industry, demonstrated that it is difficult to generalize between the SAR induced in two given heads, for people of different ages or body types (Wiart 2008). Although significant methodological improvements occurred over the last decade, in 2008 FCC reported persisting “issues and concerns in applying these [SAR] procedures correctly” (FCC OET 2008b). Additionally, two modeling studies carried out in Japan demonstrated that the whole body SAR can be substantially higher than the current standard when short subjects are exposed to high-power cell phone radiation (Hirata 2007; Wang 2006).

The current SAR standard may pose especial risk to the health of children (Martinez-Burdalo 2004). Children’s tissues have higher numbers of ions compared to adults, resulting in greater conductivity and increased capacity to absorb radiation (Gabriel 2005; Peyman 2009). Children’s heads also have smaller thicknesses of the pinna, skin and skull, reducing the distance from the handset to the peripheral brain tissues (Conil 2008; Wiart 2008). These factors result in higher SAR exposure for young children. According to a recent study with SAR testing models designed to correspond to the 5-8 year old child, a child’s head would absorb twice the radiation of an adults’ (Wiart 2008). Similar results have been reported by the University of Utah researchers in 1996 (Gandhi 1996) and by the researchers from the Nagoya Institute of Technology (Japan) in 2003 (Wang 2003). Due to higher absorption of radiation, when a child uses a high-emitting cell phone, he or she could easily get an exposure over the current FCC limit (Conil 2008).

U.S. SAR standards for cell phones

The FCC limits for cell phone radiation exposure (47CFR 2.1093(d)), based on IEEE recommendations, permit the following SAR levels for whole-body exposure and for partial-body or localized exposure (FCC 1997, 1999):

- Partial-body exposure (head): up to 1.6 W/kg, averaged over 1 g of tissue;
- Whole-body exposure: up to 0.08 W/kg, averaged over 1 g of tissue;
- Hands, wrists, feet, and ankles: up to 4 W/kg, averaged over 10 grams of tissue.

The current SAR standards for radiofrequency radiation were based on animal studies conducted in the late 1970s and early 1980s. These studies demonstrated behavioral alterations, such as disruption of food-motivated

learned behavior, in several animal species, including non-human primates (squirrel monkeys) at an SAR above 4 W/kg (IEEE 2006; Osepchuk 2003). According to the Institute of Electrical and Electronics Engineers (IEEE) International Committee on Electromagnetic Safety, these behavioral changes “may be a potentially adverse effect in human beings” (IEEE 2006).

FCC, on the recommendation of the IEEE, adopted an SAR level of 4 W/kg as the point of departure for determining legal SAR limits for cell phones. In contrast to the FCC position, an independent analysis by the EPA scientists concluded, on the basis of the same body of data, that biological effects occur at SAR levels of 1 W/kg, 4 times lower than the level chosen by IEEE (U.S. EPA 1984). The EPA’s Science Advisory Board reviewed the draft EPA report twice prior to publication. The Science Advisory Board concluded that the report “represents an adequate statement of the current scientific literature and can serve as a scientifically defensible basis for the Agency’s development of radiation protection guidance for use by Federal agencies to limit exposure of the general public to radiofrequency radiation” (SAB 1984).

Based on the EPA analysis, a point of departure at 1 W/kg SAR may well be a more scientifically defensible hazard level that should be used for determining legally acceptable exposure limits. In fact, the EPA scientist in charge of editing the 1984 report, D.F. Cahill, published a peer-reviewed paper where he indicated that SAR of 0.4 W/kg is likely to be a conservative threshold point (Cahill 1983), 10 times lower than the departure point chosen by IEEE. This conclusion is supported by a growing body of studies from researchers world-wide that observe biological effects of cell phone radiation at SAR values significantly below the limits adopted by FCC (reviewed in (BioInitiative 2007; Independent Expert Group on Mobile Phones (IEGMP) 2000)).

Of note, the IEEE-recommended SAR of 4 W/kg as the point of departure for adverse health effects corresponds to short-term exposure and does not take into account long-term or chronic exposure (RFIAWG 1999). Thus, the existing FCC cell phone standard may well be insufficient for protecting human health from potential effects of life-long use, especially for susceptible populations such as young children.

Slim margin of safety provided by the current FCC standards

The FCC standards, adopted from the 1992 IEEE recommendation, are not based on a comprehensive risk assessment and fail to provide a reasonable margin of safety for exposure to cell phone radiation. Assuming a conservative, and likely overestimated departure point for health effects at an SAR value of 4 W/kg, the exposure standard for the head, at 1.6 W/kg, has only a 2.5-fold margin from the level that produced adverse behavioral effects even though it is possibly the most sensitive part of the human body, while exposure to hands, wrists, feet, and ankles at 4 W/kg, has no safety margin whatsoever. Moreover, as discussed above, children aged 5-8 may receive twice higher SAR compared to adults (Wiat 2008), so that under the current radiation standards a young child can easily receive a level of radiation exposure at which adverse behavioral effects are observed in animals.

The approach that IEEE/FCC took to the development of the cell phone radiation standard stands in stark contrast to the risk management approach practiced by the Environmental Protection Agency (EPA). According to EPA, protective reference values should be derived in a way that accounts for both the uncertainty and the variability in the data available (U.S. EPA 2008). In this framework, variability refers to heterogeneity or diversity in the human population, such as different exposure frequencies and duration and differences in response such as genetic or age-specific difference in vulnerability to a particular physical, chemical, or biological agent. Further, uncertainty is typically due to a paucity of available information, for example, for extrapolation from animal data to humans, extrapolating from short-term to chronic exposure and lack of information on all health endpoints affected by the exposure (NRC 2008a; U.S. EPA 2002). To account for uncertainty and variability, one of several, generally 10-fold, default factors are used in EPA risk assessments for operationally deriving the reference exposure values from experimental data (U.S. EPA 2009).

The goal of applying the uncertainty/variability factors for developing general population exposure standards is to ensure that an adequate margin exists to protect infants, young children, and other vulnerable populations from harmful exposures. The choice of specific uncertainty factors (UF) depends on the quality of the studies available and the extent of the research database. EPA has developed certain general principles that apply to most risk assessments (U.S. EPA 2002):

- Interspecies UF accounts for different sensitivity between humans and laboratory test species; it generally falls between 3 and 10, but factors more than 10 might also be applied;
- Intraspecies UF accounts for variability in response between different people; this factor is generally set at 10 and needs to be higher so as to specifically protect children;
- Subchronic-to-chronic duration UF is typically set at a default value of 10 whenever the results of a short-term exposure study are used to derive a long-term exposure standard;
- Finally, for certain exposures during the vulnerable period of development, such as exposure of young children to pesticides, an additional safety factor of 10 is used (mandated under Food Quality Protection Act of 1996).

Of note, the development of the IEEE standard did not involve risk assessment and uncertainty factor considerations as applied by the EPA. A statement from a recent review on the history of the standard is very telling: “to account for uncertainties in the data and to increase confidence that the limits are below levels at which adverse effects could occur, somewhat arbitrary safety factors (typically 10-50) are applied to the established threshold” (Osephchuk 2003).

As described by the IEEE 2005 “Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields”, IEEE applies a safety factor of 10 for whole body exposure and adds an additional factor of 5 so as to “recognize public concerns and take into account uncertainties in laboratory data and in exposure assessment” (IEEE 2006). Why a factor of 5 and not 10, the default factor typically used by EPA in cases of uncertainty (U.S. EPA 2002)? According to IEEE, the International Committee on Electromagnetic Safety determined that “an additional factor of 10 was likely excessive and a factor of 2 not sufficiently differentiating from the upper tier” (IEEE 2006). IEEE has argued that even this 5-fold factor may be excessive and unnecessary and that exposure limits for the general population need to be set at the same higher level as for occupationally exposed people in the workplace (IEEE ICES 2002; Microwave News 2001). IEEE based this recommendation on an untested hypothesis that there would be no difference in sensitivity of different population subgroups to electromagnetic radiation (IEEE ICES 2002).

In its assessment, IEEE has sanctioned a 20-fold higher SAR values for the head (1.6 W/kg) than the whole-body exposure (0.08 W/kg). There are no scientific data to support this decision. As indicated in the authoritative assessment from the Radiofrequency Interagency Work Group (RFIAWG), a task force that included the National Institute for Occupational Safety and Health (NIOSH), EPA, FCC, Occupational Safety and Health Administration (OSHA), and the National Telecommunications and Information Administration, the brain may well be the most sensitive part of the human body with respect to radiofrequency radiation, and would require a more and not less protective standard (FDA 2008a; RFIAWG 1999).

Over the past several years, IEEE has been pressuring FCC to further relax the SAR standard for mobile phones, so that greater energy absorption into the head would be legally permitted (IEEE ICES 2002; Li 2006; Lin 2006; Microwave News 2001; Silva 2002). As promoted by the IEEE, the new upper limit for exposure to the head would be 2 W/kg instead of the FCC limit of 1.6 W/kg (IEEE 2006). The new IEEE standard (2006) also proposed to increase allowed SAR levels for the ear (“pinna”) from 1.6 W/kg to 4/0 W/kg, the same as current standards for hands, wrists, feet and ankles (IEEE 2006).

IEEE also proposed to switch to a method of SAR determination that involves averaging absorbed radiation over 10 g of tissue (IEEE 2006), even though it is well known that averaging over a greater volume tends to underestimate the SAR value by a factor of 2-3 (Cardis 2008; Gandhi 2002). Although so far this proposal has not been adopted by the FCC, in the past FCC had a disconcerting track record of accepting IEEE recommendations without peer review by an independent body of scientific experts (GAO 2001; Lin 2006).

U.S. cell phone certification is primarily carried out by private industry organizations

Cell phones certified by FCC for use in the U.S. must be shown to comply with the legal SAR limits. Yet, cell phone manufacturers opposed public SAR disclosure until 2000, when the FCC began posting cell phone SAR values on its web site (Lin 2000). After the FCC decision, the Cellular Telecommunications Industry Association (CTIA) began requiring manufacturers to disclose cell phone SARs.

It takes effort and persistence to locate the radiation emission (SAR) value for a cell phone either on the manufacturer's website or in the FCC database. There is no standard format for SAR disclosure by the manufacturers, so a search can be very time consuming. According to CTIA guidelines, a mobile phone SAR value must be listed in the user manual or on a separate sheet. The trade association does not require listing the SAR value on the box or the phone itself (Microwave News 2000).

The FCC Office of Engineering and Technology (OET) is the main division within the FCC responsible for cell phone certification and oversight of all radiofrequency equipment in general. FCC has several equipment approval programs, all of which involve the use of the private sector to varying degrees, including:

- **Verification** (self-approved by the manufacturer). According to 47CFR 2.902, "Verification is a procedure where the manufacturer makes measurements or takes the necessary steps to insure that the equipment complies with the appropriate technical standards. Submittal of a sample unit or representative data to the Commission demonstrating compliance is not required unless specifically requested by the Commission"
- **Declaration of Conformity** (manufacturer self-approved using an accredited lab). According to 47CFR 2.906, "Declaration of Conformity is a procedure where the responsible party, as defined in Sec. 2.909, makes measurements or takes other necessary steps to ensure that the equipment complies with the appropriate technical standards. Submittal of a sample unit or representative data to the Commission demonstrating compliance is not required unless specifically requested."
- **Certification.** According to 47CFR 2.906, "Certification is an equipment authorization issued by the Commission, based on representations and test data submitted by the applicant".

Certification of a cell phone or any other type of device can be approved by the FCC or a Telecommunication Certification Body (TCB), which is a private industry certification organization. As described in 47CFR 2.960, "The Commission may designate Telecommunication Certification Bodies (TCBs) to approve equipment as required under this part. Certification of equipment by a TCB shall be based on an application with all the information specified in this part. The TCB shall process the application to determine whether the product meets the Commission's requirements and shall issue a written grant of equipment authorization. The grant shall identify the TCB and the source of authority for issuing it."

According to the FCC, "A TCB is a private organization, which is authorized to issue grants, within its scope of designation, for equipment subject to the FCC's certification procedure. Under these rules, a TCB has the authority to review and grant an application for certification to the FCC rules" (FCC OET 2008f). Examples of devices that can receive certification either through the FCC or through a TCB include cell phones; radiofrequency lights; microwave ovens; family radio; telemetry transmitters; walkie talkies (FCC OET 2008c). Of note, the rules for FCC-TCB interaction are not listed in 47CFR. As described by an FCC representative in a conversation with EWG on April 1, 2009, FCC-TCB interaction is a "constantly developing process." Typically, FCC gives new guidelines to TCBs on an ongoing basis, usually in the format of TCB workshops held 2-3 times a year (FCC OET 2005a, b, 2006, 2008a).

Considering the widespread use of cell phones and other wireless communication devices, it is surprising that the vast majority of them do not undergo direct FCC review. FCC has defended the use of the private sector for certification and issuing grants of equipment authorization, stating that in the Agency's opinion, a private certification system allows for rapid adjustment to changing technology with shorter product life cycles; faster product approvals; access to technical expertise and ability to certify equipment; increase in resources performing conformity assessment; efficiencies in designing and approving products in the same geographic location; as well as reduced uncertainty and delay in obtaining certification (FCC OET 2005a). However, multiple issues of oversight, conflict of interest, adequate auditing and public disclosure hamper the transparency of the TCB certifications (GAO 2001).

In the TCB process, the manufacturer, an accredited lab, or a TCB can test the SAR value of a sample phone. A TCB then reviews the mobile phone test data and application for compliance. The application must demonstrate concordance with the FCC limits (47CFR2.1093(d)) for the phone to receive equipment authorization. If the review is favorable, TCB enters the product into the FCC database and FCC issues a so-called "grant of equipment

authorization” within a few days. The TCB uploads supporting information to the FCC site electronically and FCC does not review the materials before the grant of equipment authorization is issued. The manufacturer pays application fees to the TCB fees but not the FCC (FCC OET 2005a, 2008g).

A path for manufacturer application directly to FCC also exists. This path involves FCC fees, FCC examiner review and FCC engineer review. If no problems or questions arise during the FCC review, the agency issues a grant of equipment authorization in about 30-45 days from when the application was received; the process may be delayed depending on potential FCC queries (FCC OET 2005a).

Over 100 FCC-recognized TCBs exist in the U.S. alone, and the number of international FCC-recognized TCBs is much greater (FCC OET 2009). While statistics specific for mobile phones’ equipment authorization are not publicly available, in 2005, from over 7000 applications for radiofrequency equipment authorization, fewer than 1000 grants were authorized by the FCC and the rest of the applications were authorized by TCBs (FCC OET 2006). In 2006 and 2007, the number of TCB-authorized applications continued to rise to over 9000 in 2007, while the number of FCC-authorized applications remained around 500 (~ 5% of the total) (FCC OET 2008e). Specific statistics for cell phones are not available. However, statements from TCB suggest that majority of cell phones go through TCB certification, as illustrated by a representative quote from the website of Intertek, an accredited TCB:

“The FCC has designated Telecommunication Certification Bodies (TCB) to certify products for the FCC in a shorter timeframe, allowing manufacturers like you to get to market quicker. Intertek is a TCB and can help you with your FCC testing and certification in less than half the time it takes the FCC.... Partnering with Intertek for both FCC Testing and FCC Certification saves both time and money... We have expert TCB reviewers throughout the United States and Asia, enabling fast, simple, and convenient FCC testing and certification for manufacturers around the globe... Our reviewers have undergone detailed TCB training from the FCC, and they maintain a continuing education program with the FCC to stay abreast of any changes that may occur to any Part of the Rules. Each reviewer has had significant hands-on experience performing FCC tests and preparing their own applications to the FCC. We can issue your certification within days, not months. The FCC currently averages 35 days to issue certification. Since time-to-market is such a critical factor, that’s a risk not worth taking. With TCB reviewers around the world and direct links to forms and guides to help you with the process, Intertek is the answer for quick and accurate FCC testing and certification.” (Intertek 2009)

While the FCC has authority to audit any grants of equipment authorization and conduct its own verification, this happens very rarely. In 2005, FCC established an Audit and Compliance Branch within the OET Laboratory Division in order to test and evaluate various types of authorized equipment and perform TCB audits (FCC OET 2005b, c, 2008d). Initially, the Audit and Compliance branch was tasked with auditing 20% of TCB Grants; sampling and testing 2% of of the total number of products approved by TCB for a given year (FCC OET 2005b). This degree of oversight was soon found by the Commission to be insufficient and, in October 2008, FCC introduced a new set of rules for internal auditing programs that TCBs need to carry out (FCC OET 2008a). The surveillance sample amount was raised to 5% of authorized equipment, including 1% of grants for wireless devices that are subject to SAR measurements (FCC OET 2008a).

TCBs are also required to conduct post-market surveillance, auditing at least 5% of the total number of products certified by the TCB. For post-market testing, TCBs can obtain samples by requesting a grantee to submit a sample of the product certified or by purchasing a sample of the product from the marketplace. The TCB must file with the FCC an annual summary of all surveillance audits performed, and TCBs are required to notify FCC if a violation is detected (FCC OET 2008h). However, as EWG found out in a conversation with FCC Auditing and Compliance Branch on April 1, 2009, FCC does not store the audit information, and TCBs are not required to submit the actual results of their audits to FCC; in fact, auditing data are considered to be TCB's proprietary information.

Under the 47CFR rules and regulations, FCC can request a TCB to provide reports of surveillance activities carried out by the TCB or to test samples of products certified by the TCB. Occasionally, FCC conducts independent testing, usually in response to a complaint from the field. If a non-compliance or violation instance is detected, such as inappropriate radiofrequency channel use or electromagnetic interference with medical devices (FCC 2009; FCC OET 2008a, h), the FCC Enforcement Bureau (<http://www.fcc.gov/eb/>) has the authority to issue a wide range of sanctions (FCC OET 2008a). In a conversation with EWG on April 1, 2009, FCC officials indicated

that cell phone radiation emissions are generally not a subject of violations enforcement, since, in the opinion of FCC, these types of issues are resolved during the TCB/FCC certification process.

Cell Phone Radiation Science Review

Section 3: Government Action on Cell Phone Radiation Levels

Worldwide, scientists, public health experts, and many government agencies are making recommendations for children to avoid using cell phones and generally for cell phone users to aim towards lower radiation exposure (Leitgeb 2008; Mead 2008). Recommendations from government agencies of several countries and international organizations are summarized below.

Country	Agency or Organization	Recommendations on restricting children's cell phone use	Headset recommendation	Other recommendations
Switzerland	Federal Office of Public Health (FOPH 2009c)	"Either keep your calls short or send a text message (SMS) instead. This advice applies especially to children and adolescents."	"Use a wireless hands-free system (headphone, headset) with a low power Bluetooth emitter to reduce radiation to the head."	"When buying a mobile phone, make sure it has a low SAR." "Whenever possible, only use your phone when the signal quality is good." "Be wary of radiation shields and other such protective devices that are claimed to limit exposure to radiation. They may reduce the connection quality and therefore force the phone to transmit at a higher output power."
Germany	Federal Office for Radiation Protection (Bundesamt für Strahlenschutz (BfS) 2008d)	Exposure minimization for children and youngsters.	Best to use a headset instead of talking directly into the cell phone.	Use a landline telephone whenever available. Use cell phones with a low SAR value (<0.6 W/kg). Avoid making calls on a cell phone (or make shorter calls) when phone has a weak signal. Send an SMS instead of calling. (translated from German)
France	Legislation being developed by the French Senat and the Ministry of Health and Sports (Ministère de la Santé et des Sports 2009; Sénat français 2009)	Under the new legislation, "all public communication, whatever the means or support, that aim, directly or indirectly to promote sale, availability or use of cell phones by children younger than 12 years old would be prohibited. Sale or free distribution of products containing radiofrequency devices and aimed specifically for use by children younger than 6 years of age may be forbidden by order of the Health Minister, in order to limit excessive exposure of children." (translated from French)	Under the new legislation, "radiofrequency devices that would be connected to any public cell phone service provider may not be sold without an accessory device that would allow limiting head exposure to radiofrequency waves." (translated from French)	

Israel	Ministry of Health (2008)	Limiting children's use of cell phones	Use wired earpieces	Avoid cellular communication in enclosed places such as elevators and trains. (translated from Hebrew in (Azoulay 2008))
United Kingdom	Department of Health (2005)	"UK Chief Medical Officers strongly advise that where children and young people do use mobile phones, they should be encouraged to: use mobile phones for essential purposes only; keep all calls short - talking for long periods prolongs exposure and should be discouraged."		"Keep your calls short." "Consider relative SAR values when buying a new phone."
Canada	The city of Toronto's Department of Public Health (Toronto Public Health 2008a, 2008b)	"Given that cell phones are in increasingly common use by children and youth ages 10 to 19 years, it is prudent to continue to direct messages to the public so as to avoid unnecessary exposure to RFs [radiofrequencies] among young people." "While cell phones are important for communication and for safety reasons, parents should be aware of what they can do to reduce any risks from their child's use of a cell phone." "Today's children have started to use cell phones at a younger age, therefore their lifetime exposure to cell phone RFs will likely be greater. As a result, the chances that a child could develop harmful health effects from using a cell phone for a long time may be greater."	"Toronto Public Health is recommending that children, especially pre-adolescent children, use landlines whenever possible, keeping the use of cell phones for essential purposes only, limiting the length of cell phone calls and using headsets or hands-free options, whenever possible."	"Parents who buy cell phones for their children should look for ones with the lowest emissions of RF [radiofrequency] waves." "When cell phone reception is low (this happens when the base station antenna is far away) and when a cell phone is being used during high speed travel (i.e. driving in a car) power being emitted from the cell phone must be increased in order to maintain reception. Cell phone use by children should be limited during these times in order to reduce exposure to RFs."
Finland	Finnish Radiation and Nuclear Safety Authority (Säteilyturvakeskus (STUK) 2009)	"It would be good to restrict children's use of mobile phones." "Precaution is recommended for children as all of the effects are not known."	"Parents are recommended to guide their children to use a hands-free that minimises the exposure of head significantly. When using a hands-free it is recommended to keep the mobile phone at least a few centimetres away from the body."	"Parents are recommended to advise their children to use rather SMS messages than mobile phone calls." "Parents may restrict the number of their children's mobile phone calls and their duration." "STUK does not find it justifiable to totally prohibit children's use of mobile phones. Mobile phones also create safety because they make children's communication with parents easier."

Russia	Russian National Committee on Non-ionizing Radiation Protection (2008)	"Potential risk for the children's health is very high." "The current safety standards for exposure to microwaves from the mobile phones have been developed for the adults and don't consider the characteristic features of the children's organism."		"Ultimate urgency to defend children's health from the influence of the EMF [electromagnetic fields] of the mobile communication systems."
European Parliament		"[The Parliament notes] that the limits on exposure to electromagnetic fields which have been set for the general public are obsolete. They do not take account of developments in information and communication technologies or vulnerable groups, such as pregnant women, newborn babies and children. The plenary therefore calls on the Council... to set stricter exposure limits for all equipment which emits electromagnetic waves in the frequencies between 0.1 MHz and 300 GHz" (European Parliament 2008b).	"Use of hands-free kits"	"A wide-ranging awareness campaign to familiarise young Europeans with good mobile phone techniques, such as the use of hands-free kits, keeping calls short, switching off phones when not in use (such as when in classes) and using phones in areas that have good reception" (European Parliament 2009).
United States	Food and Drug Administration (FDA) Office of Women's Health (FDA 2007)			"Cell phones should expose people to the least RF [radiofrequency radiation] possible." "People who use cell phones need to be told of any bad effects."

Recommendations from governments and international agencies

Switzerland

For personal cell phone use, the Swiss Federal Office of Public Health (FOPH) states: "The effects of radiation from mobile telephony on brain function and the occurrence of brain tumours are currently under investigation. Until such time as reliable research findings are available, it is advisable to minimize exposure of the head to radiation" (Swiss Federal Office of Public Health 2009c). Swiss FOPH advises to:

- Use a wireless hands-free system (headphone, headset) with a low power Bluetooth emitter to reduce radiation to the head.
- When buying a cell phone, make sure it has a low SAR.
- Either keep your calls short or send a text message (SMS) instead. This advice applies especially to children and adolescents.
- Whenever possible, only use your phone when the signal quality is good.
- People with active medical implants should keep their cell phone at least 30 cm away from the implant at all times.

With respect to overall exposure to cell phone radiation in the radiofrequency range in the entire Switzerland, since 1999 public exposures to emissions in 900 MHz range have been restricted to 4 V/m (6 mW/cm²), while exposures in 1800 MHz range have been restricted to 6 V/m (10 mW/cm²).

Germany

For the past several years, the German Federal Office for Radiation Protection (Bundesamt für Strahlenschutz, BfS) has been advocating a cell phone SAR safety level of 0.6 W/kg (BfS 2008b). As part of this process, a "Blue Angel" eco-seal has been developed for low-emission cell phones (Blaue Engel 2008). In 2008, BfS estimated that approximately 30% of cell phones in the German market have emissions at or below 0.6 W/kg (BfS 2008b).

BfS recommends a precautionary approach to cell phone use for children, such as using a landline; making shorter cell phone calls; avoiding using a cell phone when the connection is weak; and, as much as possible, using a headset and substituting text messaging instead of making a call (BfS 2008d). BfS has also recommended the same precautions for adult cell phone users, additionally including a recommendation for purchasing cell phones with low SAR values (BfS 2007).

France

The French Senat is now considering legislation restricting the use of cell phones for children, including a ban on the advertising of cell phones to children under the age of 14, ban on sales of phones intended for use by children under the age of 6. The new legislation will also require all handsets to be sold with accompanying headsets (Bremner 2009; Le Monde 2009; Ministère de la Santé et des Sports 2009; Sénat français 2009).

Israel

In 2008, Israel's Ministry of Health stated that although it is still not clear whether cell-phone use is connected to an increased risk of developing cancerous growths, current research already supports a policy of "preventive caution" (Israel Ministry of Health 2008). The Ministry published a set of guidelines that called for limiting children's use of cell phones, avoiding cellular communication in enclosed places such as elevators and trains, and using wired, not wireless, earpieces (Azoulay 2008). The Ministry developed these guidelines following a national study that detected an association between cell phone use and the risk for developing tumors of the salivary gland (Sadetzki 2008; Traubmann 2007).

United Kingdom

The UK Department of Health supports "a precautionary approach" to the use of cell phones until more research findings become available. 2000 and 2005 editions of the Department of Health publication "Cell Phones and Health" stated that where children and young people do use cell phones, they should be encouraged to:

- Use cell phones for essential purposes only;
- Keep all calls short - talking for long periods prolongs exposure and should be discouraged.

The UK Chief Medical Officers recommend that if parents want to avoid their children being subject to any possible risk that might be identified in the future, the way to do so is to exercise their choice not to let their children use cell phones (UK Department of Health 2005).

The UK Department of Health further stated in its publication "Government Response to the Report from the Independent Expert Group on Cell phones (Stewart Group)": "Consumer should have access to the SAR values when considering purchasing a cell phone. The Government will expect SAR measurements to be displayed at all points of sale and with each cell phone and on the world wide web. The Government considers that the SAR value should be viewed in context, for example, by comparing the SAR value against the recommended exposure limits" (UK Department of Health 2004).

Finland

In January 2009, the Finnish government stated that children's cell phone use should be restricted, for example, by sending text messages instead of talking, making shorter calls, using a hands-free device, and avoiding the use of cell phones when connection is weak. According to the Finnish report, "although research to date, has not demonstrated health effects from cell phone's radiation, precaution is recommended for children as all of the effects are not known" (STUK (Finnish Radiation and Nuclear Safety Authority) 2009).

Regarding the current studies on cancer risk of cell phone use, Finnish government concluded that while “on the grounds of the studies to date, it is not possible to make such a conclusion that cell phones would cause a health risk... Since it takes years to develop a cancer and cell phones have been in common use only for about ten years, the possibility, that a link between cell phone use and cancer might be found in later population studies, cannot be ruled out” (STUK (Finnish Radiation and Nuclear Safety Authority) 2009).

Italy

In 2001-2003, Italy set an exposure limit of 60 V/m and a quality goal of 6 V/m for broadcast and cell phone transmitters in buildings where people work for more than four hours per day.

The European Parliament

The European Parliament resolution on the mid-term review of the European Environment and Health Action Plan 2004-2010, approved on September 4, 2008 by 522 votes to 16, recommended stricter exposure limits for cell phones and other wireless devices. The Action Plan review included a key section on wireless technology:

“[The Parliament notes] that the limits on exposure to electromagnetic fields which have been set for the general public are obsolete. They do not take account of developments in information and communication technologies or vulnerable groups, such as pregnant women, newborn babies and children. The plenary therefore calls on the Council... to take into account the Member States' best practices and thus to set stricter exposure limits for all equipment which emits electromagnetic waves in the frequencies between 0.1 MHz and 300 GHz” (European Parliament 2008b).

Article 22 of the 2008 Resolution highlights the importance of the precautionary approach supported by the European Environment Agency and promotes adoption of the stricter emission standards such as those developed in Belgium, Italy and Austria (European Parliament 2008a).

The European Parliament resolution on “Health concerns associated with electromagnetic fields” (INI/2008/2211), adopted by 559 votes to 22 on 2 April 2009, called for bringing greater transparency to the radiofrequency radiation exposure and for adoption of precautionary measures. The resolution stated:

- Wireless technology (cell phones, Wi-Fi/WiMAX, Bluetooth, DECT landline telephones) emits EMFs that may have adverse effects on human health. Most European citizens, especially young people aged from 10 to 20, use a cell phone, while there are continuing uncertainties about the possible health risks, particularly to young people whose brains are still developing.
- The scientific basis and adequacy of the EMF limits should be reviewed by the European Commission.
- As well as, or as an alternative to, amending European EMFs limits, the Commission, working in coordination with experts from Member States and the industries concerned, should draw up a guide to available technology options serving to reduce exposure to EMFs.
- EU member states should make available to the public, maps showing exposure to high-voltage power lines, radio frequencies and microwaves, and especially those generated by telecommunications masts, radio repeaters and telephone antennas. That information should be published on the internet.
- A wide-ranging awareness campaign should be initiated to familiarize young Europeans with good cell phone techniques, such as the use of hands-free kits, keeping calls short, switching off phones when not in use (such as when in classes) and using phones in areas that have good reception.

U.S. Food and Drug Administration Office of Women's Health

FDA Office of Women's Health released a publication in 2007 offering several recommendations:

- “More studies on cell phone RF [radiofrequency radiation] are needed.”
- “Cell phones should expose people to the least RF possible.”
- “People who use cell phones need to be told of any bad effects.”

International Commission on Non-Ionizing Radiation Protection (ICNIRP) Statement on EMF Emitting New Technologies (ICNIRP 2008):

"Recent developments in telecommunication and wireless technology have led to increasing numbers of new devices and systems that emit radio frequency (RF) electromagnetic (EM) energy. Implementing these developments has resulted in large numbers of individuals at the workplace or in the general public being exposed to RF-EMFs... There are questions being posed about health effects associated with exposure to these new systems and devices, which have not been tested per se in terms of health risks. They may have signal characteristics that are unique and different from the currently used technologies, and they may also cause the total level of exposure to rise because of the superposition of electromagnetic fields (EMFs) emitted by new and existing sources."

BioInitiative Report

In 2007, the BioInitiative Working Group, an international collaborative group of radiation scientists, cancer researchers and public health policy professionals issued the "BioInitiative Report: A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF [extremely low frequency electromagnetic fields] and RF [radiofrequency radiation])." The report highlighted extensive concerns about the safety of existing electromagnetic field radiation limits for power lines, cell phones, and many other sources of electromagnetic radiation exposure in daily life. The BioInitiative group urged for development of "new public safety limits and limits on further deployment of risky technologies" (BioInitiative 2007).

The Russian National Committee on Non-Ionizing Radiation Protection

According to the 2008 report from the Committee, children younger than 18 years of age may face increased health risks from cell phone radiation, since:

- Absorption of the electromagnetic energy in a child's head is considerably higher than that in the head of an adult because children's brain has higher conductivity, smaller size, thin skull bones, and due to smaller distance from the antenna;
- Child's organism is more sensitive to the EMF compared to adult's;
- Developing brain has higher sensitivity to the accumulation of the adverse effects under chronic exposure to the EMF;
- EMF affects the formation of the process of the higher nervous activity;
- Today's children will spend longer time using cell phones than today's adults.

As a result, in the opinion of the Committee, children are likely to face the following health hazards following long-term exposure: "disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability, sleep problems, increase in sensitivity to the stress, increased epileptic readiness" (Russian National Committee on Non-Ionizing Radiation Protection 2008).

European Environment Agency (EEA)

EEA stated that "precautionary and proportionate actions taken now to avoid plausible and potentially serious threats to health from EMF are likely to be seen as prudent and wise from future perspectives" (EEA 2007).

TCO certification program, Sweden

TCO Development, a standard-setting group owned by the Swedish Confederation of Professional Employees, develops product certifications for various types of office and electronic equipment. TCO certification program recommends a cell phone SAR value below 0.8 W/kg (TCO 2001). <http://www.tcodevelopment.com/>

Austrian Institute for Applied Telecommunications (Österreichische Institut für angewandte Telekommunikation (ÖIAT))

The Austrian Institute for Applied Telecommunications in co-operation with the Austrian Federal Chancellery, the Federal Ministry for Social Security, Generations and Consumer Protection, and Mobilkom Austria developed an information website, Handywissen.at, with recommendations for cell phone use. While the ÖIAT does not consider that the current state of science indicates health risks from cell phones, their website provides tips for the cell phone users such as:

- If possible, do not make phone calls when the signal quality is poor (as displayed by the number of bars on the phone). If the reception is poor, the cell phone automatically increases radiation strength to transmit the signal.

- Use hands-free equipment (headset). Regardless of whether a wired head set or Bluetooth is used - headsets reduce the radiation exposure to the head from the cell phone.
- Attention: radiation protection products (for example, a cell phone sticker) are mostly counterproductive or have no physical effect.
- Use cell phone models with a low SAR value.
- For shorter information exchange, send SMS.
- Radiation emitted by the cell phone is highest in the first moment of establishing connection. Bring the cell phone to the ear after the person on the other end of the line responds (Austrian Institute for Applied Telecommunications 2008). (translated from German)

Eurobarometer survey

In 2006-2007, the European Commission Directorate General for Health and Consumer Affairs commissioned a survey of public perception of health risks associated with electromagnetic fields. The survey found:

- Two-thirds (65%) of EU citizens are not satisfied with the information that they receive about potential health risks linked to EMF and consider available information “insufficient.”
- Across the European Union, the vast majority (80%) of citizens do not feel that they adequately informed on the existing protection framework relating to potential health risks of electromagnetic fields.
- Majority (60%) of the European public does not consider public authorities to be efficient enough in protecting them from potential health risks.

Cities taking action

Toronto, Canada

In 2008, the Toronto's Department of Public Health stated: “Research on the health effects from cell phone RFs on children is very limited since the use of cell phones by young people is a relatively new trend. Scientists are not yet sure what the health effects in children are from using a cell phone. While research continues in this area, some scientists feel that children may be more susceptible to harmful effects of RFs from cell phones for several reasons:

- Pre-teen children have a smaller head and brain size, thinner skull bones, skin and ears.
- Their nerve cells also conduct energy like RFs more readily than an adult's or teenager's nerve cells.
- Children's brains and nerves are also still developing so they are likely to be more sensitive to exposures of RFs.

Today's children have started to use cell phones at a younger age, therefore their lifetime exposure to cell phone RFs will likely be greater. As a result, the chances that a child could develop harmful health effects from using a cell phone for a long time may be greater” (Toronto Public Health 2008b).

“Children, especially pre-adolescent children, use landlines whenever possible, keeping the use of cell phones for essential purposes only, limiting the length of cell phone calls and using headsets or hands-free options, whenever possible (Toronto Public Health 2008a)”. “Parents who buy cell phones for their children should look for ones with the lowest emissions of RF waves... When cell phone reception is low (this happens when the base station antenna is far away) and when a cell phone is being used during high speed travel (i.e. driving in a car) power being emitted from the cell phone must be increased in order to maintain reception. Cell phone use by children should be limited during these times in order to reduce exposure to RFs” (Toronto Public Health 2008b).

Brussels, Belgium

In 2007, the Brussels Capital-Region of Belgium adopted a maximum limit for exposure to 900 MHz frequency radiation in all publicly accessible zones at 0.024 W/m² (corresponds to electric field strength of 3 V/m), significantly lower than the FCC maximum permissible exposure (Centre Démocrate Humaniste (cdH) 2007; Parlement de la Région de Bruxelles-Capitale 2007). While the majority of GSM cell phone towers in Belgium transmit at levels below 3V/m, certain stations transmit at significantly higher levels, up to 25 V/m (Belgian Institute for Postal Services and Telecommunications 2009). Following the regional Brussels decision in 2007, the cell phone operators and the Belgian federal Health Ministry jointly challenged the 3V/m rule in court. In January 2009, the Belgian Constitutional Court ruled that individual regions of Belgium have a right to set more strict

radiation emissions standards to protect the health of their citizens (Ecolo 2009; Huytebroeck 2009a). The 3 V/m measure is set for implementation in the Brussels region from September 2009 (Huytebroeck 2009b).

Salzburg, Austria

In 2000, the city of Salzburg has adopted a "precautionary strategy" by setting the maximum exposure level for GSM (Global System for Mobile communications) cell phone base stations at 0.1 mW/cm².

Christchurch, New Zealand

Christchurch Council in New Zealand established a public exposure limit for radiofrequency radiation at 2 mW/cm². The standard was challenged in a lawsuit but was upheld by the judge of the South New Zealand Environment Court.

United States: The National Research Council report and research by the National Toxicology Program

In 2008, the National Research Council of the National Academies issued a report, "Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication". According to the report, outstanding research needs in the area of cell phone health effects include: 1) characterization of exposure to potentially vulnerable populations such as children, pregnant women and the developing fetus, and people with special sensitivities; 2) prospective epidemiological studies of childhood cancers, including brain cancer, and their potential relationship with cell phone use; 3) human laboratory studies that focus on possible adverse effects on electric potentials (brain waves) and neural networks in various parts of the brain; 4) ongoing research of potential biophysical, biochemical, and molecular mechanism of radiofrequency radiation action on living tissue; 5) dosimetry studies with different cell phones and other types of wireless devices and the SAR that they can deliver to different parts of the body (NRC 2008b). FDA has been an official partner with the National Research Council in identifying outstanding research needs in cell phone exposure and health effects research (FDA 2008b).

The National Toxicology Program, in collaboration with several academic centers across the U.S. and internationally, is now developing a large-scale, long-term series of studies to examine the health effects of cell phone radiation in experimental animals (both mice and rats) (Capstick 2008; McCormick 2008; Melnick & Portier 2005). The study partners include the IIT Research Institute (Chicago) and the Foundation for Research on Information Technologies in Society (IT'IS, Switzerland), with animal exposure system operation independently validated by U.S. National Institute of Standards and Technology (NIST, Boulder, CO).

The NTP studies will re-examine the thermal effects of radiofrequency exposure on animals, analyze the health effects of the perinatal pre-chronic exposure (scheduled for completion in 2009), and identify any chronic toxicity or oncogenicity (scheduled for completion in 2011) (McCormick 2008). The overall objective of these studies is to determine the potential toxic and/or carcinogenic effects of exposure to cellular phone radiofrequency emissions in laboratory animals. This information would then be used to determine the adequacy of current guidelines for protecting against potential adverse effects of chronic exposure (Ball 2008).

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Section 4: Radiation - Bluetooth, Wired Headsets & Cordless Phones

There is a great need for publicly available information on radiation emission levels associated with cell phones. This disclosure should be done at the point of sale.

A recent market study indicated that shoppers considered the SAR value of a phone important for their safety and a key element of their purchasing decision (Wiedemann 2008). Yet, as found in a 2006 survey by the German Federal Office for Radiation Protection, only 11% of respondents considered themselves well informed on the subject of cell phone radiation (BfS 2008c).

Using a headset is one of the simple, easy steps that consumers can take to decrease their exposure to cell phone radiation. Yet, which headset to use - wired or wireless? The research below discusses the latest science on the subject.

Bluetooth radiation emissions

According to findings and recommendations by government agencies and researchers in different countries, the use of Bluetooth headsets with cell phones decreases the overall levels of SAR exposure to the head (American Cancer Society 2008; BfS 2005; Martinez-Burdalo 2009; Swiss Federal Office of Public Health 2009a).

Bluetooth wireless technology is found in a diverse range of devices, such as cell phone headsets, car speakerphones and other automotive equipment, GPS, gaming equipment, computer accessories such as printers, keyboards, and mice, PDAs (personal digital assistants), personal media players, and medical, health, and wellness devices (CNET Reviews 2009; ICNIRP 2008; Morrow 2002). Bluetooth wireless technology allows radiofrequency devices to form connections for communicating one-on-one or for creating a personal wireless network within an approximately 30-foot-radius sphere. Bluetooth devices are used in a growing number of commercial and personal applications; the Bluetooth Specialist Interest Group, an industry trade association, lists over 6000 products that utilize Bluetooth technology (Bluetooth Special Interest Group 2009).

Bluetooth transmitters operate at frequency around 2.4 GHz. Bluetooth devices are assigned to one of three power classes: 1, 2 and 3. Class 2 transmitters – most commonly found in mobile devices – have a range of 30 feet (10 meters) and operate at 2.5 mW peak transmission power; class 3 devices are weaker than class 2, operating at peak transmission power of 1 mW in a range of less than 10 meters. Class 1 transmitters are the most powerful, with a range of 300 feet and peak transmission power of 100 mW. Class 1 Bluetooth devices can cause exposure to radiation similar to that emitted by a cell phone if they are operated in the immediate vicinity of the body. Bluetooth devices are designed to limit the radiation power exactly to that actually required. When the receiving device indicates that it is a few meters away, the transmitter immediately modifies its signal strength to suit the exact range, which reduces the total emitted radiation and signal interference (IT'IS 2005).

A study commissioned by the Swiss Federal Office of Public Health (FOPH) measured SAR for several Bluetooth devices, including two different class 3 hands-free cell phone headsets. The headsets tested had SAR values of 0.001 and 0.003 W/kg, which is 34 and 12 times lower than the SAR of the lowest-emission cell phone currently available (Swiss Federal Office of Public Health 2009a).

Of note, while the Bluetooth headset reduces radiation exposure to the head, transmission strength from the phone itself is not decreased. Bluetooth headset users frequently keep their phone in a pocket or clipped to the belt, a position that leads to radiation exposure of internal organs (Whittow 2008). As stated on the FCC website, "if the phone is mounted against the waist or other part of the body during use, then that part of the body will absorb RF energy" (FCC 2008). While the health effects of this exposure have not yet been assessed, the Swiss FOPH recommended that "cell phones should not be carried in a front trouser pocket when making calls" and that it may be safest "to hold the phone away from the body to reduce radiation exposure" (Swiss Federal Office of Public Health 2009a). Furthermore, a study from the Loughborough University (U.K.) reported that realistic everyday metallic objects found near the waistline, including a coin, a ring and a zipper increased the SAR in the body at different frequencies (Whittow 2008).

In the U.S., FCC certification of Bluetooth devices does not require measuring and reporting the SAR values. Bluetooth technology falls under the list of “low-power, non-licensed radiofrequency devices” that are classified in 47CFR Part 15 (FCC 1993, 2002). According to the FCC regulations, these unlicensed devices need to comply with the maximum permissible exposure limit. As stated by FCC:

"The FCC typically does not require RF exposure test data to be submitted with a filing to demonstrate compliance. Sometimes, applicants may choose to include such test data to expedite a filing. However, sufficient information should be included to satisfy the requirements of Section 15.247(b)(4), typically specific operating and installation instructions/requirements, warning/caution instructions and/or labels when applicable. If compliance cannot be ensured or determined based on the supporting information, (the operating configurations and exposure conditions of the host and final products that would operate with the Bluetooth transmitter module.) SAR or MPE evaluation may be requested as required by Section 1.1307(d)." (FCC 2007)

Wired (corded) hands-free headsets — radiation emissions

The use of corded earpieces/headsets is listed by the American Cancer Society as one of the easy ways to decrease SAR exposure to the head and brain during a cell phone conversation (American Cancer Society 2008).

With a corded headset, the voice signal is sent electronically to the earpiece directly from the phone in a similar manner as when standard headphones are plugged into a radio or a music player (Network & Academic Computing Services of University of California Irvine 2008). Depending on the position of a wired headset cable along the body, a certain proportion of the phone output radiofrequency radiation can be transmitted along the cable and elicit measurable SAR values in the torso and the head of the user (Kuhn 2008).

In the U.S., wired headsets are not regulated and their SAR values are generally not publicly available (Carnoy 2000). Several studies examined the issue of corded headsets safety, the potential for the headset/headset wire to act as a secondary antenna, and the effects of headset wire on radiation exposure to the torso (Carnoy 2000). One conclusion is clear: radiation exposure to the head is reduced with the use of a cordless headset, according to studies from the School of Electrical & Electronic Engineering at the Queen's University of Belfast (Troulis 2003) and the University of York Department of Electronics reached similar conclusions (Porter 2004) and Motorola (Bit-Babik 2003).

The Motorola study reported that, with a headset, SAR in the head is 8 times lower than when making calls holding the phone to the ear (Bit-Babik 2003). While this is a significant decrease, some degree of radiation exposure to the head occurs nevertheless (Bit-Babik 2003), which stands in contrast to statements from wired headset manufacturers that “SAR readings at the head are virtually zero when a corded mobile headset is used” (Plantronics 2005).

Unlike the earlier publications, a 2008 study carried out in the framework of the German research program on mobile telephones found that under a worst-case scenario for use of a GSM 1800 cell phone there was an increase in the SAR value in the inner ear (Kuhn 2008). It is possible that SAR exposure to the head when using a wired headset may be dependent on the cell phone transmission frequency and the type of transmission system, although researchers concluded that when a headset is used the overall exposure in the region of the head is reduced (Kuhn 2008).

Importantly, using a corded headset does not decrease the radiation output of the cell phone, which becomes absorbed into the torso instead of the head (FCC 2008). The Troulis (2003) study reported that for a waist-mounted cell phone, absorption of radiation by the body reduces the phone's efficiency, thus increasing the required output power level. In this study, the peak 1 g SAR value was 0.450 W/kg for the phone itself, and with the hands-free wire connected, SAR increased to 1.14 W/kg. For a phone worn near the waist, this increased radiation would be absorbed into the body.

Scientific consensus has not yet been reached on whether corded or wireless headsets provide best radiation protection to the head and sensitive internal organs. Headset use has been recommended by government agencies in several countries as a way to reduce radiation exposure to the head (Switzerland, Germany, France, Israel, Austria, and the city of Toronto). According to the Swiss government, “As the brain is a sensitive organ, it is

wise to use a hands-free kit (headset), since this reduces exposure of the head to radiation” (Swiss Federal Office of Public Health 2009a). Yet, which one is best?

Israel’s Ministry of Health urges cell phone users to rely on a wired, not wireless headset; the Swiss government recommends a wireless hands-free system (headphone or a headset) with a low power Bluetooth emitter; the Austrian government recommends using either a wired or a wireless headset; the German Federal Office for Radiation Protection and the city of Toronto’s department of Public Health simply recommend the use of headsets without stating which one is preferable. The UK Department of Health stated in a 2005 publication that the level of effectiveness of hands-free kits to reduce SAR is still uncertain (UK Department of Health 2005). Recent publication from the Swiss Foundation for Research on Information Technologies in Society (IT’IS) recommended for manufacturers to conduct tests of wired headsets’ SAR values to ensure that the phone-to-headset cable does not transmit radiofrequency radiation towards the head and to the torso (Kuhn 2008).

While research on safer wireless technology is ongoing, one conclusion is clear: whether using either corded or Bluetooth headsets, it is reasonable to choose a phone with the lowest SAR value and to keep the cell phone away from the body during use.

Other common sources of radiofrequency radiation exposure

In addition to exposures from cell phones and Bluetooth devices, people are exposed to EMF radiation from a wide range of wireless devices at home and in the workplace, such as cordless home phones, baby monitors, and Wireless Local Area Networks (WLAN) (Frei 2009; Hillert 2006). Scientists at the Foundation for Research on Information Technologies in Society (IT’IS, Switzerland) reported an SAR value of 0.077 W/kg for baby monitor; 0.055 W/kg for cordless phone, and 0.81 W/kg for WLAN (IT’IS 2005). Additionally, IT’IS found that a class 1 Bluetooth USB plug-in antenna had an SAR of 0.466 W/kg, while a class 2 Bluetooth USB plug-in antenna had an SAR value of 0.0092 W/kg (Swiss Federal Office of Public Health 2009a). While research on this question is only beginning, a recent study from Spain suggested that cell phone exposures constitute the majority of radiofrequency exposure for an individual person, significantly exceeding exposure due to other wireless devices such as Bluetooth or WLAN (Martinez-Burdalo 2009).

Several studies on the association between cell phone use and cancer have raised question about the potential health impact of radiofrequency radiation from cordless home phones which is the same type of radiation as that emitted by cell phones (Hardell, Carlberg 2006b; Hardell 2003; Mild 2007). A recently published study from Switzerland found that people who owned either a cordless phone or a mobile phone received more exposure to radio frequency radiation than those not owning either type of phone (Frei 2009).

While the cordless phone handset emits radiation only during a call (same as a cell phone), radiation emission from the cordless phone base station are continuous even when no calls are made (BfS 2008a). The German Federal Office of Radiation Protection recently issued a new requirement for cordless home phone models whereby base stations must be automatically switched off when not in use or when in standby mode (BfS 2008a). The Swiss government recommended keeping cordless phone base units away from relaxation places or work stations occupied for long periods as well as using a corded phone or a headset instead of a standard cordless phone (Swiss Federal Office of Public Health 2009b).

In the U.S., the types of cordless phones and the radiofrequency range they use have changed over the years. In early 1980s, cordless phones operated with frequency of 27 MHz (Phone Warehouse 2000). In late 1980s, FCC changed the cordless phone frequency band to 47-49 MHz (Code of Federal Regulations Chapter 47, section 15.233), followed by cordless phones that operated in 900 MHz range (cell phone frequency), 2.4 GHz (frequency band also used by Bluetooth and wireless LANs) and 5.8 GHz (Pedro 2006; teqFAQ 2009). The range of a cordless phone increased with each subsequent generation; 900 MHz phones have a range of 200 to 1500 feet, while 2.4 GHz and 5.8 GHz have a range of 300 to 2000 feet (Hanks 2004). New technologies such as DECT (Digital Enhanced Cordless Telecommunications) operate in 1900 MHz (cell phone) range (Rhein Tech 2006).

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) recently recommended that public officials setting standards for EMF radiation exposure need to consider simultaneous exposure to radiation from multiple devices, such as cell phone, cordless home phone, Bluetooth, and WLAN, needs (ICNIRP 2008).

Similarly, the Swiss and German governments have recommended precaution with respect to increasing exposure to radiofrequency devices (BfS 2008a). The Swiss government stated that "caution should be exercised primarily when using devices held close to the body, such as laptops, PDAs and Internet telephones" (Swiss Federal Office of Public Health 2009d). Clearly, this question needs to be resolved with a nation-wide study of the total EMF exposure people face on a daily basis.

Rapid growth in cell phone technology

Cell phone technology is constantly developing. Currently, GSM (Global System for Mobile Communication) is a standard protocol for digital mobile communication used for phone calls and transmission of text messages. Cell phones are also used for sending data or surfing the Internet. GPRS (General Packet Radio System) and Edge (Enhanced Data Rate for Global Evolution) are further developments of GSM that can transfer data at higher rates (sometimes called 2.5 Generation systems). The new (third) generation in mobile telecommunications includes W-CDMA (Code Division Multiple Access) and UMTS (Universal Mobile Telecommunication System), which have higher data transfer rate than GSM and are better suited to data and multimedia services while providing same level of cell phone and text messaging service. It is expected that in the near future, 3G technology will supersede the GSM standard (ICNIRP 2008; Swiss Federal Office of Public Health 2009c).

GSM protocol operates at frequencies of 900 and 1800 MHz; 900 MHz protocol has a peak output power of 2000 mW and maximum output power of 240 mW. 1800 MHz protocol operates with a peak output power of 1000 mW and maximum output power of 120 mW. 3G UMTS protocol operates at transmission frequency 2100 MHz, with both peak and maximum output power in the range of 125-250 mW.

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Cell Phones - Plants; Review: Weak Radiofrequency Radiation
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Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants.

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Author information

Abstract

AIM: The aim of this article was to explore the hypothesis that non-thermal, weak, radiofrequency electromagnetic fields (RF-EMF) have an effect on living plants.

SUBJECT AND METHODS: In this study, we performed an analysis of the data extracted from the 45 peer-reviewed scientific publications (1996-2016) describing 169 experimental observations to detect the physiological and morphological changes in plants due to the non-thermal RF-EMF effects from mobile phone radiation. Twenty-nine different species of plants were considered in this work.

RESULTS: Our analysis demonstrates that the data from a substantial amount of the studies on RF-EMFs from mobile phones show physiological and/or morphological effects (89.9%, $p < 0.001$). Additionally, our analysis of the results from these reported studies demonstrates that the maize, roselle, pea, fenugreek, duckweeds, tomato, onions and mungbean plants seem to be very sensitive to RF-EMFs. Our findings also suggest that plants seem to be more responsive to certain frequencies, especially the frequencies between (i) 800 and 1500 MHz ($p < 0.0001$), (ii) 1500 and 2400 MHz ($p < 0.0001$) and (iii) 3500 and 8000 MHz ($p = 0.0161$).

CONCLUSION: The available literature on the effect of RF-EMFs on plants to date observed the significant trend of radiofrequency radiation influence on plants. Hence, this study provides new evidence supporting our hypothesis. Nonetheless, this endorses the need for more experiments to observe the effects of RF-EMFs, especially for the longer exposure durations, using the whole organisms. The above observation agrees with our earlier study, in that it supported that it is not a well-grounded method to characterize biological effects without considering the exposure duration. Nevertheless, none of these findings can be directly associated with human; however, on the other hand, this cannot be excluded, as it can impact the human welfare and health, either directly or indirectly, due to their complexity and varied effects (calcium metabolism, stress proteins, etc.). This study should be useful as a reference for researchers conducting epidemiological studies and the

KEYWORDS: Base station; RF-EMF; mobile phones; physiological and morphological changes; plant growth; plants; radiofrequency electromagnetic fields

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Microwave Emissions From Cell Phones Exceed Safety Limits in Europe and the US When Touching the Body

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ABSTRACT In our publications, we have shown both from measurements and computer modeling that the specific absorption rate (SAR) reduces by 10%–15% for every millimeter separation of the cell phone on account of rapidly diminishing EM fields in the near-field region of the cell phone antenna. This rapid reduction of SAR depending on the antenna and its location on the handset has been shown, both computationally and experimentally, regardless of the phantom model such as a flat phantom suggested for SAR compliance testing of devices in contact with the body, for a sphere phantom, and for head-shaped models used for SAR compliance testing of cell phones. Unfortunately, our observations in the past were based on SARs of only three cell phones. Expecting that the SARs for cell phones may exceed the safety limits for body contact, cell phone manufacturers have started to recommend that the devices can be used at 5–25 mm from the body even though it is difficult to see how to maintain this distance correctly under mobile conditions. The National Agency ANFR of France recently released the cell phone SAR test data for 450 cell phones that measure 10-g SARs reducing by 10%–30% for each millimeter distal placement from the planar body phantom. Their data corroborate our findings that most cell phones will exceed the safety guidelines when held against the body by factors of 1.6–3.7 times for the European/ICNIRP standard or by factors as high as 11 if 1-g SAR values were to be measured as required by the U.S. FCC.

INDEX TERMS XXXXX.

I. INTRODUCTION

Safety guidelines for radiofrequency (RF) microwave radiation have been proposed by the expert committees in the United States (Institute of Electrical and Electronics Engineers, IEEE) and by the International Committee for non-ionizing radiation protection (ICNIRP) of World Health Organization (WHO) [1], [2] as well as expert committees in Canada, Japan, Australia, etc. While the guidelines suggested by IEEE are followed by the U.S. Federal Communications Commission [FCC] in Washington, DC, the ICNIRP Standard is followed in Europe and many other countries in the world.

The IEEE safety guidelines followed by the FCC prescribe that the microwave emissions of a personal wireless device be limited to ensure that the mass-normalized power absorbed in any part of the body except limbs (specific absorption rate or SAR) does not exceed 1.6 W/kg for any 1 g of tissue

in the shape of a cube [3]. The ICNIRP guideline is more lax and prescribes that the microwave radiation for such wireless devices not create an SAR in any part of the body of more than 2.0 W/kg for any 10 g of tissue. In published literature it has been reported that because of a larger volume for 10 g of tissue the ICNIRP standard will permit radiated powers of cell phones to be 2.5 to 3 times higher than those allowed by the IEEE/FCC standard [4]. The regulatory agency FCC requires that the personal wireless devices marketed in the U.S. meet the IEEE C95.1-1992 standard, thereby requiring lower radiated powers so as not to exceed SAR of 1.6 W/kg in any 1 g of tissue in the shape of a cube for all parts of the body except the limbs (“extremities” such as hands, pinna, or the legs).

II. RECENTLY SUGGESTED CHANGES BY INDUSTRY

Whereas the cell phones are often used held against the ear canal or against the body in shirt or pant pockets and are therefore very close to the body, the cell phone manufacturers

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TABLE 1. SARs in W/kg measured for some representative telephones held against the flat phantom model of the body at manufacturer-suggested distances D and at distances of 5 and 0 mm as for actual use by consumers (taken from ANFR Test Report [10]).

Make	MODEL	SAR at Mfr. Suggested Distance D	SAR (5mm)	SAR (0mm)	Percent increase in SAR for	
					From D to 0mm	From 5 to 0mm
POLAROID	PRO 881A	1.05 (15 mm)	3.63	7.42	13.90%	15.40%
HTC	ONE SV	0.366 (15 mm)	2.256	7.183	22.00%	26.10%
BLACKBERRY	Z 10	0.934 (15 mm)	3.18	6.8	14.20%	16.40%
MOTOROLA	MOTOLUXE	0.254 (25 mm)	2.96	5.86	13.40%	14.60%
ORANGE	NEVA 80 (ZTE BLADE V770)	1.39 (15 mm)	3.62	5.79	10.00%	9.90%
HUAWEI	P9 (EVA-L09)	1.32 (15 mm)	3.18	5.6	10.10%	12.00%
MOTOROLA	RAZR I	0.507 (25mm)	2.27	5.51	10.00%	19.30%
SONY	XPERIA S CITIZY LT26i	0.748 (15 mm)	2.253	5.45	14.20%	19.30%
APPLE	IPHONE 5	0.825 (10 mm)	1.453	5.321	20.50%	29.60%
SAMSUNG	GALAXY S 5 SM-G900 F	0.545 (15 mm)	1.55	3.55	13.30%	18.00%
ECHO	NOTE	1.35 (5 mm)	1.35	4.15	25.20%	25.20%
APPLE	IPHONE 5C	1.11 (5 mm)	1.11	3.11	22.90%	22.95%
SAMSUNG	GALAXY J7 (SM-J710FN)	1.29 (5 mm)	1.29	3.56	22.50%	22.50%

in the last 5-10 years have started to recommend that they be held 5, 10, or 15 up to 25 millimeters from the body. We assume this additional spacing between the cell phone and the body was recommended because of our past publications that these wireless devices will not pass the safety standards when held against the body on account of the very rapidly diminishing EM fields close to radiating antennas [4]–[7], [10]. In spite of the manufacturer recommendations, we find it hard to believe that one can carry out a conversation when the telephone is held up to 25 millimeters away from the ear canal particularly in crowded noisy environments or that these recommended distances can be maintained consistently under mobile conditions without use of a spacer to maintain the suggested distances of 5 to 25 millimeters.

III. RECENT ANFR (FRANCE) CELL PHONE TEST MEASUREMENTS

On June 1, 2017, the National Agency (ANFR) of France released the cell phone SAR test results on hundreds of cell phones that they had been testing at accredited laboratories since January 2012 [9] using a two-sided version of the IEEE-recommended SAM model or a flat body-simulant model. The ANFR tests differed from regulatory tests in that they measured SARs with separation distances D recommended by individual manufacturers as well as placements that were closer at 5 and 0 millimeter to mimic actual use conditions by consumers holding the wireless device against the body, e.g. in their pockets where SARs higher than the safety limits have also been previously reported by us in peer reviewed published literature [10].

The ANFR test program measured the 10 g SAR called for in the European/ICNIRP standard at three positions of use:

the manufacturer-suggested distance D (5, 10, 15, or 25mm) and 5 and 0 mm as for most likely use close to the body (5 mm presumably because of thickness of clothing). A strength of the ANFR results is they have tested 450 cell phones as against our very limited data based on 3 telephones [6], [10]. As the ANFR had tested a large number of cell phones resulting in a very large report [9], we decided to select a limited number of 13 telephones for this paper to illustrate the results. The SARs measured for these 13 selected cell phones are given in Table 1. Shown in this Table is that the telephones give SARs that are within ICNIRP guideline of 2.0 W/kg for manufacturer-suggested distances D (5, 10, 15, or 25 mm), but give SARs that are considerably higher than those of ICNIRP guidelines (by factors of 1.6 to 3.7 times) when the telephones are held against the body to mimic likely actual use conditions. In this context it should be mentioned that the SARs would be even higher by an additional multiplier of 2.5 to 3 or a factor of up to 11 times higher if 1 g values required by the IEEE/FCC standard were measured. All of the 13 selected ANFR-tested devices of Table 1 will not pass the US/FCC safety compliance requirement of 1.6 W/kg for any 1 g of tissue [3]. In the last column of Table 1 we give the calculated increase of SAR per millimeter of reduced spacing for each of the wireless devices from manufacturer-recommended distance D to zero and from 5 mm to zero, respectively. The increase in SAR for each millimeter of proximal placement of the wireless device varies from 10 to 30% which is higher than our previously reported results of 10-15% based on a very limited number—only three cell phones. However the ANFR results do reinforce our additional previously published observations [5] that Standard Anthropomorphic Mannequin (SAM) with tapered plastic

spacer that creates an artificial separation of the wireless device by 6-10 mm will reduce the measured SAR and cannot be trusted as a method for SAR compliance testing. Another thing to observe from the data in columns 4 and 5 is that the SAR is higher by a factor of 2 to 3 for a 5-millimeter closer placement of the wireless device. In [6] we have also proposed this as the reason for a higher SAR for children and for women and men with thinner pinna and skulls resulting in radiating wireless devices being placed closer to the brain in stronger radiated EM fields.

IV. INTERPRETATION OF THE ANFR TEST RESULTS OF TABLE 1

All 13 of the selected telephones of Table 1 fail the SAR requirements mandated by the ICNIRP/European Standard and the US FCC Standard because of the following considerations:

- 1) The ICNIRP guidelines state that the 10-g SAR for conditions of actual use be no more than 2 W/kg and FCC requires compliance with IEEE Standard C95.1-1991 [1] which is set in terms of 1 g SAR of 1.6 W/kg. It has been shown in peer-reviewed published literature [4], [6] that because of the fairly shallow penetration of RF energy coupled to the tissues, the 1 g SAR is typically 2.5-3 times the 10-g SAR.
- 2) For cell phones held against the pinna, the measured 1 or 10 g SAR will also be much higher if SAM had not used the lossless artificial plastic spacer in lieu of the tissue-simulant human pinna. As pointed out in [5] and [6], the tapered plastic spacer artificially separates the radiating cell phone antenna by up to 10 mm additional spacing for the RF coupled regions of the head resulting in underestimation the 1 g and 10 g SAR by a factor to 2-4. This factor of 2-4 higher SAR is also borne out by the ANFR the ANFR measured results in Table 1 where higher values of SAR are reported in columns 3 and 4 that are for separation distances of 15 and 5 mm respectively.

V. CONCLUSIONS

It is important that safety compliance testing be done under realistic conditions of actual use of the cell phones by the present day users. This should include telephones held close to the body at 0 millimeter spacing and against the tissue-simulant pinna rather than a pinna simulated by a tapered plastic spacer. For the latter, phantom models of the actual users such as children and women and men of smaller head sizes should be used rather than the large head size of Army Recruits used for SAM. The children and women are known to have thinner pinna and skulls which results in closer placements by several millimeters of the radiating antennas to the brain. It is not sufficient for manufacturers to start recommending that the microwave radiating devices be held at distances of 5 to 25 millimeters away from the body to reduce measured SAR to meet the safety standards since these suggested distances cannot be maintained correctly without

use of properly attached spacers. Even though ANFR of France has to date released the higher SAR data that does not meet the safety compliance standards when the telephones are held against the body, similar results have also been obtained by independent testing in Canada [11].

Because of the increasing popularity of wireless phones all over the world with use by over 90-95% of populations, it is important that the regulatory agencies in various countries define correct conditions for SAR testing that will cover a majority of users including children.

ACKNOWLEDGMENT

The author would like to thank the contributions of Dr. Marc Arazi of Paris, France, in providing the English translation of the fairly large ANFR TEST Report [9] and Ms. Theodora Scarato in carefully preparing a shortened version of the large ANFR report with data on 450 tested devices into columns 1-5 of Table 1 for 13 selected telephones for illustrative purpose.

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Cancer - NTP; The Significance of Primary Tumors in the NTP Study of Chronic Rat Exposure to Cell Phone Radiation. IEEE Microwave Magazine.
Prof. James C. Lin; 2019



Health Matters

The Significance of Primary Tumors in the NTP Study of Chronic Rat Exposure to Cell Phone Radiation

■ James C. Lin

Most media accounts of the U.S. National Toxicology Program's (NTP's) final report have understandably focused on the statistically significant finding of "clear evidence" that both GSM and code-division multiple access (CDMA)-modulated 900-MHz wireless RF radiation led to the development of malignant schwannoma, a rare form of tumor, in the hearts of male rats. In addition to this, unusual patterns of cardiomyopathy, i.e., damage to heart tissue, were observed in both RF-exposed male and female Sprague-Dawley rats compared with concurrent control animals, although the findings for female rats were deemed as providing only uncertain or "equivocal" evidence for schwannomas and malignant gliomas, compared to concurrent controls [1], [2].

The results, however, also included pathology findings showing positive indications or "some evidence" of carcinogenic activity in the brains

of male rats, specifically glioma. (The designation of "some evidence" for carcinogenicity was based on the NTP's classification of the strength of observed evidence in its report.) It is important to note the National Institute of Environmental Health Sciences/NTP's statement: "We believe that the link between RF radiation and tumors in male rats is real, and the external experts agreed" [3].

The study also concluded that there were positive findings of carcinogenicity in the adrenal gland. The number of pheochromocytomas, i.e., tumors of the adrenal gland, was significantly higher in male rats at 1.5 and 3 W/kg of specific absorption rates (SARs), compared to the concurrent controls. Moreover, the increase in malignant tumor-like hyperplasia in the adrenal glands of female rats was significantly higher at 6 W/kg, relative to the concurrent controls. The myriad carcinogenic observations of the NTP study have prompted questions

about total primary cancer occurrences in these chronically exposed animals.

A Closer Look at the NTP Findings

In all fairness, the primary cancer or overall cancer rates detected in any organ or tissue inside the animal body do not appear to have been purposefully overlooked or unnoticed. Indeed, the results for total primary cancer or tumor occurrences in NTP animal studies can be found in the appendices of its final reports [1]. However,

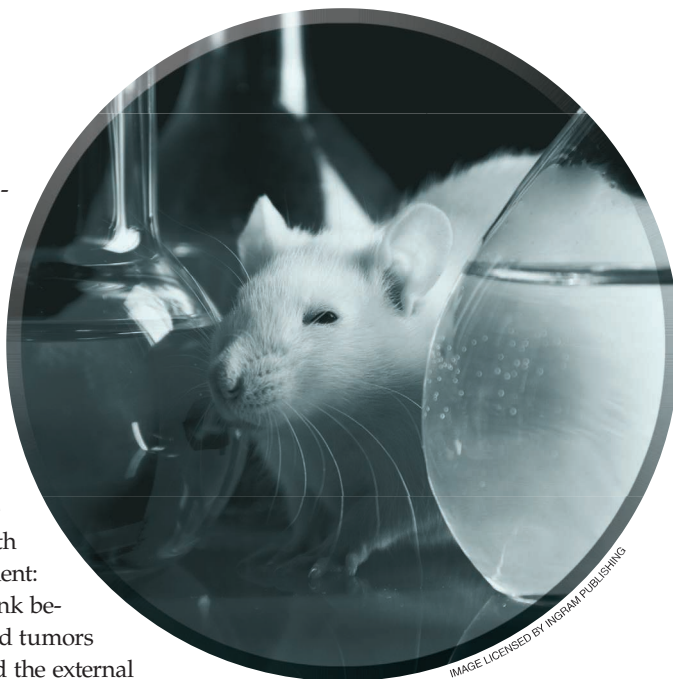


IMAGE LICENSED BY INGRAM PUBLISHING

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although the data may not have been purposefully disregarded or ignored, the NTP excluded them from its publicized report summaries. An independent analysis of the data showed that rats exposed to GSM and CDMA RF radiation had significantly higher overall or total primary tumor rates than did the concurrent control rats [4].

In particular, the highest overall cancer (or malignant tumors) rates were found in male rats exposed to whole-body SARs of 3 W/kg from 900-MHz cell phone RF radiation (42 and 46% for GSM and CDMA, respectively), and the lowest rate was found in the concurrent control group (27%). Thus, the RF-exposed groups had significantly higher overall or total primary cancer rates than did the concurrent control rats. Moreover, the highest overall tumor rates (either a benign or malignant tumor in any organ or tissue) were observed in male rats exposed to SARs of 3-W/kg (87 and 84% for GSM and CDMA, respectively) cell phone RF radiation. As stated previously, the lowest rate was seen in the concurrent control group (63%). The RF-exposed groups had significantly higher overall tumor rates than did the concurrent control rats. Male rats in the lowest RF-exposed groups (whole-body SARs of 1.5 W/kg) had significantly higher rates of benign primary tumors (76 and 73% for GSM and CDMA, respectively) than did concurrent or sham control groups (54%).

Other Studies

Many laboratory rat cancer studies have been conducted and reported during the past quarter century in an attempt to assess the possible health risks of microwave and RF radiation from wireless communication devices and systems [5]. To date, not including the NTP investigation mentioned previously, there are six published studies on the carcinogenic potential of two-year or lifelong exposure of Sprague–Dawley rats to RF and microwave radiation. Some of these investigations involve the use of cocarcinogens to evaluate the potential of cell phone RF radiation, especially with

regard to the induction and promotion of neural and mammary tumors. In one study, rats were injected with a known neural carcinogen, ethylnitrosourea, followed by exposure to 860-MHz RF to evaluate any increases in brain tumor induction. In four papers, the promotion of 900-MHz RF radiation was tested using dimethylbenzanthracene-induced mammary tumors in female Sprague–Dawley rats.

Only one of the six earlier research studies involving Sprague–Dawley rats was designed to examine the health effects of lifelong exposure to pulsed microwave radiation. Beginning at eight weeks of age and continuing daily for 21.5 h/day, male Sprague–Dawley rats (100 each for exposure and sham control) were individually irradiated in circularly polarized waveguide exposure chambers for up to 25 months [6]. Pulsed 2,450-MHz microwave power—modulated at 8 Hz, pulsed at 800 Hz and delivered at 0.144 W to the exposure chamber—produced 0.15 to 0.4 W/kg of whole-body averaged SARs. A statistically significant increase was observed in primary cancers at death, i.e., 18 exposed rats versus five in sham-exposed control, or 18 and 5%, respectively. A near-fourfold increase of primary cancers in the exposed animals is provocative. The biological significance of this difference was questioned at the time; however, these data cannot be considered artifacts because different statistical analyses have led to similar results. The fact remains that the total primary cancer or overall cancer rate is significantly elevated in the RF-exposed group.

The most recent 900-MHz reverberation chamber and the previous 2,450-MHz circular waveguide systems provided near-zone, whole-body exposure conditions. In fact, these are the only two currently available RF and microwave exposure studies employing the Sprague–Dawley strain of rats—without, however, using any

cancer-promoting agents (or cocarcinogens). Despite the methodological differences, both investigations showed consistent results in significantly increased total primary cancer

or overall tumor rates for exposure to whole-body SARs of 1.5, 3, and 6 W/kg in one case and 0.15 and 0.4 W/kg in the other. What makes these two RF and microwave radiation animal cancer studies so valuable is the good laboratory practice with which the studies were conducted and the remarkable consistency

of total primary or overall cancer findings.

Considering SARs

A few words of description are in order to place SARs in their proper perspective. SARs are accepted metrics or measures that correspond to the relative amount of RF and microwave power deposition or energy absorption rate in a part of or the whole body (e.g., any part of a user of a wireless device or cell phone handset or the entire body in the radiation domain of a Wi-Fi antenna or base station). In the United States, the RF and microwave exposure rules established by the U.S. Federal Communications Commission (FCC) are based on SARs and maximum permissible exposure (MPE) limits [7]. The basic restrictions for human exposure are defined by SAR limits. MPE limits are derived from SAR limits in terms of free-space field strength and power density.

For exposures from cell phones, the FCC specifies a quantity of local-tissue SAR of 1.6 W/kg, as found in any 1 g of body tissue. In addition, a value of 0.08 W/kg in any 1 g of body tissue was set for whole-body exposures. The FCC rules impose basic restrictions on SAR limits for general public and occupational exposures to avoid whole-body heat stress and excessive localized tissue heating, specifically

The RF-exposed groups had significantly higher overall or total primary cancer rates than did the concurrent control rats.

to prevent biological and health effects in response to an induced body temperature rise of 1 °C or more for an average time of 6 min [7], [8]. This level of temperature increase results from the exposure of individuals under moderate environmental conditions to a whole-body SAR of roughly 4 W/kg for approximately 30 min. A whole-body average SAR of 0.4 W/kg was chosen as the restriction to provide protection for occupational exposure. An additional reduction factor of five was introduced for public exposure, giving an average whole-body SAR limit of 0.08 W/kg. This value was purposefully relaxed by a factor of 20 to permit a maximum local-tissue SAR of 1.6 W/kg.

It is noteworthy that the then-recognized protection afforded by the whole-body SAR of 4 W/kg is within the same range of 1.5-, 3-, and 6-W/kg NTP-study SARs. Furthermore, these SARs did not raise the body temperature of exposed rats by more than 1 °C. Similarly, for the earlier 2,450-MHz study at lower whole-body SARs of 0.15 and 0.4 W/kg, a body temperature elevation was not reported in the exposed rats. Nevertheless, both experimental studies revealed consistent results in significantly increased total primary cancer or overall tumor rates.

Another point that should be noted with regard to SARs is that the NTP study report indicated that an RF field uniformity within 10% was achieved throughout the reverberation exposure chamber. This level of field uniformity enabled similar SAR values throughout the rats' bodies. Specifically, the local SARs in the brains and hearts of rats were a mere 1.05 and 2.27 times the whole-body average SAR, respectively. This also means that tissues and organs inside

the rats' bodies experienced similar SARs from RF exposures.

IARC Assessment

The International Agency for Research on Cancer (IARC) assessed the then-available scientific literature and concluded that the epidemiological studies on humans that had reported increased risks for malignant gliomas and acoustic neuromas among heavy or long-term users of cell phones were sufficiently strong to support a classification of 2B, i.e., possibly carcinogenic to humans [9]. With its classification of RF radiation as a 2B carcinogen, the IARC suggested that it also believed the available scientific evidence was incomplete and limited, especially with regard to results from animal experiments.

The time is right for the IARC to upgrade its previous epidemiology-based classification of RF exposure to higher levels in terms of the carcinogenicity of RF radiation for humans. Recently, two relatively well-conducted RF and microwave exposure studies employing the Sprague–Dawley strain of rats—without, however, using any cancer-promoting agents (or cocarcinogens)—showed consistent results in significantly increased total primary cancer or overall tumor rates in animals exposed to RF radiation.

Postscripts

In August 2018, the Cesare Maltoni Cancer Research Center at the Ramazzini Institute in Bologna, Italy, published the final results from its comprehensive study on carcinogenicity in Sprague–Dawley rats exposed (either lifelong or prenatal until death) to 1,800-MHz GSM RF radiation [10]. The study involved whole-body exposure of 2,448 male and female rats under plane-wave equivalent or far-zone exposure

conditions with incident electric-field strengths of 5, 25, and 50 V/m (the frequency-dependent maximum allowable value is approximately 61 V/m [11]). The authors estimated that the whole-body SARs were roughly 0.001, 0.03, and 0.1 W/kg during exposures of 19 h/day for approximately two years. Assuming a differential factor of 20 between the average whole-body SAR and local-tissue SAR, as was done in setting safety guidelines, the corresponding local-tissue SARs could be 0.02, 0.6, and 2.0 W/kg, in this case.

A total primary or overall cancer rate was not reported in this article, due to uncertainty about whether it could be part of the study protocol; however, a statistically significant increase in the rate of schwannomas in the heart of male rats was detected for the highest RF field strength (50 V/m). Furthermore, an increase in the rate of heart Schwann cell hyperplasia was observed in exposed male and female rats at the highest RF field strength (50 V/m), although this was not statistically significant. An increase in the rate of gliomas was observed in exposed female rats at the highest field strength (50 V/m), but it was not deemed statistically significant.

It is important to note that the recent NTP and Ramazzini animal RF exposure studies presented similar findings in heart schwannomas and brain gliomas. The increased schwannomas and abnormal heart tissue development/damage to heart tissue are significant findings in RF-exposed animal research studies. In addition to this, the incidence of benign pheochromocytomas of the adrenal medulla was found to be higher in the exposed group than in the sham controls for the 2,450-MHz circular waveguide experiment [6]. Interestingly, in the recent NTP study, there was “some evidence” of carcinogenicity in the adrenal gland. The number of pheochromocytomas was significantly higher ($p < 0.05$) in male rats at 1.5 and 3 W/kg, compared with the concurrent controls. Moreover, the increase in malignant tumor-like

hyperplasia in the adrenal gland of female rats was significantly higher at 6 W/kg, relative to the concurrent controls ($p < 0.05$).

A particular perspective to keep in mind is that, with the induction of cancer by a carcinogen, an agent is typically considered carcinogenic if it induces a significant response in a specific tissue.

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MicroBusiness (continued from page 15)

project C, 5% to project D. Sometimes project E would be added to the mix. The outcome of taking on too much is predictable: everything suffers. Prescribing how to allocate resources in minute detail doesn't help. When resources are limited, dividing them into smaller pieces does not increase the total.

"Shiny New Object" Syndrome

We often have to deal with a related problem. Let's say we've pared down our projects and have all of our resources appropriately allocated. Then something new comes up: the shiny new object. This is neither hypothetical nor rare. Most organizations involved in R&D or product development can expect to have new opportunities and ideas come up. It seems to be a particularly significant issue with start-ups.

Shiny new objects are distracting. They will demand some attention, even if only to determine if they are worth looking at more closely. Making such a determination should be the role of either the engineering manager,

the marketing manager, or both. If the decision is to take a closer look, some engineering resources will need to be allocated, and something else will suffer. And if there is a further decision to pursue, some other project will likely need to be sacrificed.

There are different types of shiny new objects. Sometimes it's a variation on something that's underway, a new requirement. The trick here is to not distract the engineering team with multiple simultaneous requirements. If one key requirement for the project significantly changes or if a significant new specification or function is added, a decision needs to be made. Should we delay the project to address the new needs? Should we refocus the effort for the new requirements? If there are too many of these shiny new objects in succession, the project may never be completed. Sometimes, the most important thing is to finish a project, to get a product on the market and so generate revenue and collect valuable feedback.

For a start-up, the challenge can be worse. Most start-ups begin with a specific target: a product and application. And, in most cases, that initial target changes. After all, a start-up is developing something new. This means that the technical approach hasn't been fully demonstrated and productized. It also means that the market for the product hasn't been confirmed. Start-ups need to be nimble and adaptable. If there's a core technology, it can likely be used in multiple ways. It's probable that adjacent ideas and inventions will arise. Start-ups have limited resources, often very limited resources, so they need to focus. The trick is to focus on the right thing. The last thing a start-up can afford is to become paralyzed by too many tasks. This necessarily contributes to the high failure rate of start-ups.

So keep in mind that it's important to be selective, to keep an organization's work aligned with its resources. In these cases, "no" might be the most positive thing a leader can say.



Yes the Children Are More Exposed to Radiofrequency Energy From Mobile
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Yes the Children Are More Exposed to Radiofrequency Energy From Mobile Telephones Than Adults

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ABSTRACT Our reports of published research in several of the peer-reviewed journal articles in 1996, 2002, and 2004 have generated a lot of controversy over the last two decades, including the most recent publication by Foster and Chou. In this paper, we present arguments based on physics that the main reason for higher exposure of children (also women and men with smaller heads and likely thinner pinnae) to radiofrequency energy from mobile phones is the closer placement of the cell phone radiation source by several millimeters to the tissues of the head, e.g., the brain. Using heterogeneous anatomically derived shaped models of the head, we have previously reported that the exposure increases by a compounding rate of 10%–15% for every single millimeter of closer location of the radiating antenna. This is similar to the report of ~20% increase for every millimeter in the Foster and Chou's paper from their (1) even though their simplistic (1) is valid only for a homogenous tissue slab of infinite size and the radiation source that is a wire dipole rather than a mobile telephone. Both of their assumptions for (1) are obviously not applicable for human exposures to mobile telephones. Actually, the physical reason for such a rapid drop off of coupled energy is that the radiofrequency electromagnetic fields close to a radiating source in the so-called near-field region reduce in strength very rapidly with every millimeter of distance, even faster than in the far-field region, where the electromagnetic fields reduce inversely with the square of the distance from the source.

INDEX TERMS Mobile telephones, exposure of children, antennas and radiation, EM compatibility.

I. INTRODUCTION AND BACKGROUND

To their credit, the authors Foster and Chou [1] recognize in their abstract that the discussion for this topic can be “limited to dosimetric issues” including possible age-related differences in the heads of mobile phone users (sic children, women and people with smaller heads and thinner pinnae (“the fleshy outside part of the ear” [1])). And yet they muddle up our claims in published literature [2]–[6] dating back to 1996 that children, women, and men with smaller heads would absorb higher radiofrequency energy in the head including the brain by presenting a bombastic roster of 23 studies using a variety of complex head models in [1, Table 2] leading to their insinuating caption, “Are children more exposed to RF energy from mobile phones than adults?”.

In this paper, we will present logical arguments based on easy-to-understand physical concepts that led to the conclusions presented in our papers [2]–[6] that children, women, and people with smaller heads with thinner pinnae will absorb more RF energy as compared to adult males

with larger heads and thicker pinnae. The physical arguments that have often been very helpful in dosimetric evaluations do not and need not depend on complex models used by a roster of 23 individual authors itemized in Table 2 of the Foster and Chou article [1].

While Foster and Chou mention some of our published papers [2], [3], [6] they do not mention our other papers [4], [5] that address the important role of reduced distance of the radiofrequency (RF) radiating source of the mobile telephone for individuals with thinner pinnae in drastically increasing the SAR measure of RF absorption by 10-15% for every single millimeter of closer placement of the cell phone source of radio frequency radiation for such individuals.

In [4] we have studied, both experimentally and computationally, the peak spatial (ps) average 1- and 10-g SAR for three commercial mobile phones and a fourth canonical telephone of dimensions typical of a mobile phone for increasing separations of 2-8 millimeters from a flat phantom (of dimensions 30 × 30 cm suggested by FCC

for testing of laptop devices) and a sphere phantom of diameter 21.2 cm similar to the dimensions of the adult head.

The highlights of the results presented in [4] are the following:

1. The psSAR both for 1-g and 10-g tissues increases at a compounding rate of 10-15% for each millimeter closer placement of a radiating telephone for the flat phantom as well as the sphere phantom [4] and even for the heterogeneous anatomically based head models [5]. Shown in Figures 1a, b, and c are the variations of the peak 1- or 10-g psSAR for both “the Visible Man Model” and the Utah Anatomic Model derived from MRI (magnetic resonance images of a male volunteer) as a function of separation (0, 2, 4, and 6 millimeters) from the absorptive tissues for two different monopole antennas on assumed handsets of dimensions typical of mobile phones [5]. For each of the cases in Figures 1a, b, and c, the psSAR increases monotonically at the rate of 10-15% for each millimeter closer placement of the radiating antennas from the anatomically based models.

It is interesting to note that our observation of 10-15% reduction of psSAR in Figures 1a, b, and c is similar to the nearly 20% reduction calculated from Eq.1 in the Foster and Chou article [1] for each millimeter distal placement of the radiator even though they have used a simplistic semi-infinite block of homogenous tissue material and a dipole radiating antenna rather than mobile phones with handsets. Both of these gross assumptions are certainly not representative of the human head nor the mobile phone. As mentioned in the abstract of this paper, the main reason for such a drastic reduction of SAR is that the electromagnetic fields of an antenna drop off very rapidly in the so-called “near-field” region of the antenna faster even than in the “far-field” where the fields drop off as the square of the distance from the source.

Nevertheless the Foster and Chou observation in [1] of nearly 20% reduction in psSAR is interesting and qualitatively similar to 10-15% reduction of psSAR reported in [3]–[5] which led us to conclude that “smaller heads of children (and women and leaner adults) are often accompanied by thinner pinnae (and skulls) which leads to a closer placement of the source of radiofrequency radiation to the tissues of the head, e.g., the brain, hence larger absorption of radiofrequency energy radiated by mobile telephones.

2. To address the issue of possible age-related changes in the dielectric properties of human tissues, in [3] we have also studied the variation of psSAR with the dielectric properties of the various tissues of the head. In [7] and [8] it has been reported that the dielectric properties of the various tissues are substantially higher (by 50% or more) for

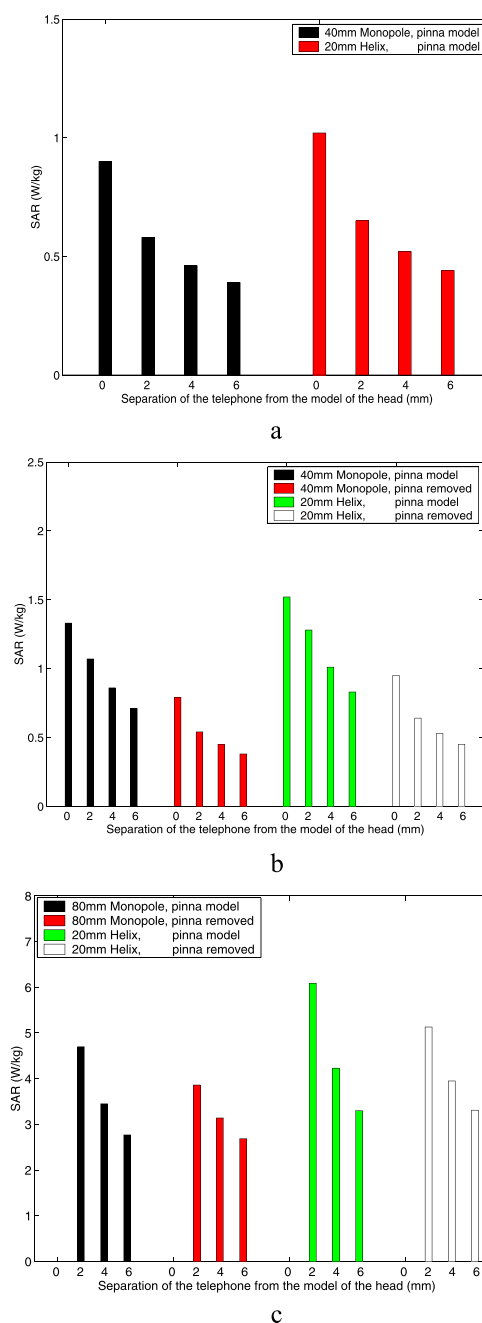


FIGURE 1. Variation of peak 1- or 10-g SAR as a function of separation from the absorptive tissues. Handset of dimensions $22 \times 42 \times 122$ mm. (Excerpted from Gandhi and Kang [5].) a. 10-g SAR, “Visible Man” Model, cheek position, frequency = 1900 MHz, radiated power = 125 mW. b. 10-g SAR, Utah Model, 15° -tilted position, frequency = 1900 MHz, radiated power = 125 mW. c. 1-g SAR, Utah Model, 15° -tilted position, frequency = 835 MHz, radiated power = 600 mW.

younger rats compared to adult rats. The authors Peyman *et al.* [7], [8] hypothesize that the decrease in the dielectric properties with age may be due to changes in water and organic contents of the tissues. Even though the corresponding data are not available for the human tissues, the implications for the assessment of exposure of children may be quite significant.

In [3] we examine the effect of possible higher dielectric properties of the tissues of the head for the children (both the electrical permittivity and conductivity) at 835 and 1900 MHz to show that likely higher dielectric properties of the tissues will further increase the aforementioned higher SAR for children (because of more proximal placement by several millimeters of the RF radiation source to the heads of children).

3. To further understand the role of the head size, we have used in [3] two distinct head sizes, one based on the MRI scans of a Utah male volunteer, the so-called Utah Anatomic Model, and the "Visible Man Model" developed by the National Library of Medicine, Bethesda, MD, from MRI and CAT scans of a husky 105 kg (231 lb.) male cadaver [5]. For each of these two models, we postulated two additional models of the head size by using scaled larger or smaller models that are approximately 10% larger or 10% smaller for each of the dimensions and assumed various thicknesses for the pinna (6, 10, 14, and 20 millimeters) as well as the pinnae with lossless properties similar to the plastic spacer SAM accepted by FCC for SAR compliance testing [9]. Such head models are well within the variations in the head dimensions encountered for adult males and females. Furthermore, to generalize the conclusions, we assume diverse handset and antenna dimensions. Based on these studies we report in [5] that a model with thinner pinna of 6 mm thickness gives peak 1-g SAR that is up to 2.5 times higher at 1900 MHz and up to 1.7 times higher at 835 MHz as compared to the same model with thicker pinna of thickness 20 mm [see Figures 1a, b, and c reproduced from ref. 5 here].

CONCLUSIONS

Since the main reason why children, women, and people with thinner pinnae and skulls absorb more radiofrequency energy is because of the placement of the cell phone radiating source closer to the brain (increasing by 10-15% for every additional millimeter of reduced spacing, determined by using planar, spherical and head-shaped models [2], [5]), it is very hard to understand why the FCC allows the use of a large SAM model of dimensions derived from the 90th percentile head size of the U.S. Military recruits for psSAR compliance testing against safety guidelines. Furthermore, the FCC-accepted SAM model has a tapered smooth plastic spacer instead of actual tissue pinna which can artificially separate the radiofrequency radiation source of the mobile phone by up to 10 millimeters at some locations resulting in an underestimation of both 1- and 10-g psSAR for male heads and for children and women by two or more times [5].

In closing, it is fortuitous that several authors worldwide have now validated our original findings that children, women, and individuals with smaller heads absorb more

radiofrequency energy from mobile telephones. Many of these independent findings are itemized in the lengthy Table 2 of the Foster and Chou article [1]. Of particular note are their references to Wiart et al. in France [their ref. 17; year 2005; ref.10 here], Keshvari and Lang in Finland [their ref. 16; year 2005; ref. 11 here], de Salles et al. in Brazil [their ref. 9; year 2006; ref.12 here], Christ et al. in Switzerland [their refs. 23, 32; years 2004 and 2010; refs. 13, 14 here], and Lu and Ueno in Japan [their ref. 25; year 2012; ref. 15 here] which corroborate our findings of higher radiofrequency absorbed energy for children (and women and leaner males) that is because of thinner pinna and skull which results in a closer placement of the radio frequency radiating source to the tissues of the head, e.g., brain.

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Children Absorb Higher Doses of Radio Frequency Electromagnetic Radiation From Mobile Phones Than Adults

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ABSTRACT The greater vulnerability of children to the effects of environmental hazards has raised concerns about their exposure to and the resultant absorption of mobile phone radiation. Foster and Chou (2014) reviewed published studies that used computer models of radio-frequency electromagnetic fields to estimate and compare the tissue dose rate in the heads of children and adults using mobile phones. Their review confuses exposure with absorption, and the study results conclude erroneously that children are not more exposed than adults. We show that their review was not executed systematically. There are discrepancies between text summaries and the graphed ratios of child: adult peak specific absorption rate, in line with the author's hypothesis that children have the same or lower tissue dose than adults. Even the underlying precept of their review is flawed, as the results of deterministic models are treated as random variables. In fact, model results are entirely determined by the underlying assumptions and the structure of the model. Models are included in their unsystematic review that do not consider differences in dielectric constants among different tissues, or across ages, while other models that consider such differences are not included. In this paper, we discuss the differences between exposure and tissue absorption and re-examine the results presented by Foster and Chou. Based upon our review, we suggest an alternative interpretation of the published literature. In an Appendix, we discuss modeling of tissue dose in the context of governmental safety certification processes.

INDEX TERMS Blood-brain-barrier (BBB), certification process, children, dosimetry, exposure-limits, EMR (electromagnetic radiation), FACTS (Finite difference time domain Anatomically Correct Tissue Specific), FDTD (finite-difference, time-domain), RF (radio frequency) SAM (specific anthropomorphic mannequin), SAR (specific absorption rate), virtual family (VF), WTDs (wireless transmitting devices).

I. INTRODUCTION

In recognition of the unique sensitivity of children to environmental health hazards, the U.S. Environmental Protection Agency, in 1996, adopted a National Agenda to Protect Children's Health from Environmental Threats [1], and in 1997 established an Office of Children's Health [2] dedicated to determining how to ensure that environmental policies adequately protect children. Although considerable attention has been paid to reducing chemical hazards in environments frequented by the young, relatively little focus has been applied to physical hazards such as those posed by radio-frequency electromagnetic radiation (RF-EMR) emitted by mobile phones and other wireless transmitting devices (WTDs).

To the extent that RF-EMR poses a risk, is that risk uniquely elevated in children? Foster and Chou [3] argue

that children have the same exposure to the brain as adults, and face equal risks, based on their review of studies comparing the intracranial dose rates of absorbed RF-EMR in adults and children. Others, for example Gandhi [4], contend that children have proportionally greater intracranial peak tissue dose given their thinner skulls and the higher water content of their cerebral tissues. Moreover, the rapid rate of growth and development, and incomplete myelination of the brain, make children uniquely susceptible to the effects of radiation [5], [6].

The current study considers the methods used by Foster and Chou [3] to identify and abstract data from relevant studies. The results of these studies, as presented by Foster and Chou, were examined in detail in an effort to understand why their conclusions differ from those drawn by other authors.

II. EXPOSURE VERSUS DOSE

The distinction between exposure and dose is fundamental to environmental health research. When considering a potentially toxic substance, exposure is the amount of that substance that is ingested, inhaled, or deposited on the body. In the case of radiation, such as RF-EMR, exposure is the duration and intensity of radiation that reaches the surface of the body. The term “tissue dose,” on the other hand, refers to the amount of radiant energy absorbed by a specific tissue, and the “dose rate” is the energy absorbed per unit time.

The Specific Absorption Rate (SAR), which is the focus of the Foster and Chou analysis, is a measure of the tissue dose rate of microwave radiation, *not* exposure. The dose is the specific absorption (SA), typically measured in Joules per kilogram (J/kg). The reports assembled by Foster and Chou compare estimated dose rates in the heads of adults and children using simulation models that, by design, have the *same exposure*. Thus the flaws in this paper begin with its title, “*Are Children More Exposed to Radio Frequency Energy From Mobile Phones Than Adults?*” This is an important question, but the topic their paper actually reviews should be restated as: are peak RF-EMR doses from mobile phones higher in children than adults? Thus, the paper’s title conflates exposure and dose.

III. REVIEW METHODOLOGY

Recognizing that this is an article on tissue dose rate, the following section considers whether Foster and Chou provide a systematic, comprehensive, meaningful, and objective review consistent with current scientific practice.

A literature review, whether qualitative or quantitative, involves, at a minimum, three principal steps: 1) literature search and report selection, 2) abstraction of study attributes and results, and 3) analysis of abstracted data. The use of meta-analysis is desirable whenever possible [7]–[9].

A. STUDY SELECTION

The validity of a scientific review is rooted in the comprehensive identification of relevant research. Missing or excluding potentially relevant studies opens the door to bias, but bibliographic search strings and methods used to assemble the Foster and Chou review were not presented. Studies were selected “that permit a direct comparison of SAR in heads of children and adults from use of mobile phones . . . limited to dosimetric issues [of] age-related differences . . . [3].” Twenty-three studies were reviewed, all of which use finite difference time domain (FDTD) calculation methods.

The major differences among the selected studies involve the design of the simulation models, which have evolved steadily with the growth in computing power. Early models were relatively simplistic, using spheres [10] and cylinders as crude approximations of the human head. All of these early models required the simplifying assumption that human tissue was a uniform, undifferentiated substance, characterized by a single set of dielectric constants, and child head models were merely scaled down adult models. As a result,

the only differences between the tissue dose in adult and child models resulted from either the position of the phone or the penetration into additional anatomical regions resulting from the smaller head size. Refinements in recent years using the Talairach atlas (available since 1988) allow for model improvements based on high-resolution characterization of brain tissues, including adjustments for higher water content in younger brains, which, as a result, absorb RF-EMR more avidly [11].

In 2005, investigators at the U.S. Food and Drug Administration working together with researchers at the Swiss IT’IS Foundation developed a set of digital human models of the entire body, not just the head, with organs and tissues in anatomically correct locations [12]. These models, which became known as the Virtual Family (VF), incorporated tissue-specific parameters for conductivity and permittivity, and a series of researchers have introduced other FDTD Anatomically Correct, Tissue Specific (FACTS) models [13].

By coupling data from high-resolution MRI scans of a broad range of subjects, researchers around the world, including teams in Brazil [14] and Korea [15], have added to the library of available FACTS models. Currently the VF has more than a dozen different models, including male and female children of various ages, men, women and even pregnant women at 1, 3, 7 and 9 months gestation [13]. Additional models continue to be introduced. Absorption related parameters are derived from empirical measurements of dielectric parameters in animal tissues of various ages immediately after death. The models and WTD antennae can be configured in any possible position, to predict the effects of exposure of tissues of various sensitivities.

Foster and Chou acknowledge that, prior to the introduction of FACTS models, simulations “were not designed to explore the effects of human variability on SAR, which on the basis of [36] and other studies are considerable.”

Despite the fact that this statement seems to suggest that these older models would not be suited to identifying differences in tissue dose, Foster and Chou included many such studies. Of the 22 distinct studies (2 are companion studies [24], [25]) in their Table 2, only ten used FACTS models [20]–[24], [26], [28], [29], [31], [35]. Foster and Chou lumped these FACTS models together with ten older, less sophisticated models spanning 19 years (1994–2012), which simply used scaled down, non-FACTS models of adult heads to model children without any consideration for the models’ limitations.

B. DATA ABSTRACTION

To summarize a series of studies concisely, reviewers must distill the findings of any particular study into a few numbers. If the process of abstracting three or four statistics to characterize an entire paper is not done according to a clear, systematic protocol with meticulous attention to detail, a strong potential for bias is introduced.

The papers that were selected by Foster and Chou reported modeling exercises that differed in important ways.

TABLE 1. Comparisons of qualitative study results from Foster and Chou [3] as summarized in their Table 2 and the quantitative results depicted in their Figure 1.

Papers Listed in Foster and Chou Table 210.5		Child/Adult Tissue Dose from Foster and Chou Table 2	Child/Adult psSAR based on Foster & Chou, Figure 1 [3]				Model Adult/Child (ages)*
Year	Authors		psSAR _{1g}		psSAR _{10g}		
			Low Band	High Band	Low Band	High Band	
1996	Gandhi 5 y [16]	>1	1.5	0.9	NR	NR	MRI/Scaled†
	Gandhi 10 y	>1	1.1	0.8	NR	NR	
2002	Gandhi & Kang [17]	>1	0.95	0.75	NR	NR	MRI/Scaled
2003	Anderson et al. [10]	>1	1.3	NR‡	1.25	NR	3-layers spherical
2003	Wang & Fujiwara [18]	>1	1.25	NR	1.25	NR	MRI/Scaled
2005	Hadjem et al. [19]	>1	0.75	0.9	0.95	0.85	MRI/MRI & Scaled
2005	Wiert et al. [20]	>1	0.95	0.9	0.9	1.05	FACTS/MRI & Scaled
2006	de Salles et al. [14]	>1	1.6	1.7	1.15	1.65	??/Scaled
2008	Wiert et al. [21]	>1	0.9	0.6	1.25	1.05	FACTS/FACTS
2011	Wiert et al. [22]	>1	Excluded from Figure 1				FACTS/FACTS (Fetus, 5, 8, 12)
2012	Lu & Ueno [23]	>1	Excluded from Figure 1				FACTS/FACTS (6,11)
2010	Christ et al. [24], [25]	>1	NR	1.1§	NR	NR	FACTS/FACTS
1998	Schönborn et al. [26]	≅1	1.1	0.95	0.95	1.05	FACTS/MRI (3, 7)
2005	Bit-Barbik et al. [27]	≅1	0.9	NR	0.95	NR	??/Scaled
2005	Christ et al. [28]	≅1	NR	NR	0.95	1.1	FACTS/FACTS (3)
2009	Peyman et al. [29]	≅1	Excluded from Figure 1				FACTS/FACTS (3, 7), walkie-talkie
2010	Hadjem et al. [30]	≅1	Excluded from Figure 1				NR / NR (9, 15)
2011	Keshvari&Heikkila[31]	≅1	0.9	0.5	0.75	0.75	FACTS /Scaled
1994	Dimbylow&Mann[32]	≅1	1.05	0.75	0.95	0.75	Phantom/Scaled
2002	Lee et al. [33]	<1	0.9	1.0	0.9	1.0	MRI & CT/ Scaled (5 ages)
2006	Beard et al. [34]	<1	1.0	0.8	0.75	0.75	1 phantom; 2 MRI/ Scaled?
2004	Martinex-Burdalo et al[35]	Unclear	0.9	1.0	0.9	1.0	MRI/ Scaled
2005	Keshvari & Lang [36]	Unclear	NR	NR	0.6	0.75	FACTS/Scaled (2)

* This column describes the technique used to generate the adult model/child model. MRI=model anatomy generated from MRI, FACTS model is a FDTD Anatomically Correct Tissue Specific Model. Where relevant, the age of the child used to generate models is listed.

† Child model scaled proportional to an adult model.

‡ Not reported.

§ Table 2 of Foster and Chou lists two studies with this author for 2010 [24], [25], but only one description mentions a specific comparison of child and adult doses. We have assumed this is the paper referenced in their Figure 1.

These include: the precise positioning and nature of the radiation source; the ages of the simulated heads; the degree to which different tissue characteristics are considered (if at all); and most importantly, the specific choice of anatomical simulation model. A table summarizing these variables for the collection of studies would have been extremely informative.

Table 1 of the current paper summarizes the literature selection, modeling designs and summary of results depicted Figure 1 and Table 2 of Foster and Chou [3].

C. INCONSISTENCIES BETWEEN TABLE 2 AND FIGURE 1 IN FOSTER AND CHOU

Comparison of Foster and Chou's Table 2 and Figure 1 suggests a pattern of inconsistencies and errors in extracting information. Although their Table 2 includes almost no numerical data, a careful reading of the text summaries allows classification of most studies according to which age group had a higher peak tissue dose rate. Based on these determi-

nations, as shown in Table 1 of this paper, 11 of 22 distinct studies [10], [14], [16]–[24] concluded tissue doses were higher in children, 7 found no difference [26]–[32] and only 2 found higher doses in adults [15], [33]. In 2 cases the text summaries were unclear [34], [35]. In other words, studies reporting higher doses in children outnumber those reporting higher doses in adults by a ratio of more than five to one, according to the text summaries of the study results provided by Foster and Chou in their Table 2.

Figure 1 from Foster and Chou does not accurately reflect the information provided in their Table 2. Figure 1 from their paper depicts 57 ratios of child/adult psSAR as abstracted from 19 studies. Of these values, 14 (25%) indicate higher peak dose in children, 17 (30%) found little or no difference (0.95 – 1.05), and 26 (46%) found higher peak dose in adults. Of all the values in Figure 1 from Foster and Chou [3], 60% were greater than 1.00. Yet, according to Table 2, the percentage of studies that concluded that psSAR was higher in

children was 57% while only 10% concluded that doses were higher in adults. Figure 1 indicates psSAR ratios both above and below unity for many studies, yielding ambiguous results. For two studies summarized as reporting higher absorption in children, all of the values in their Figure 2 represent higher peak dose in adults [17], [19]. Because the authors did not pool results quantitatively, the reader can not make conclusions with respect to whether or not the combined studies suggest the ratio of peak dose for children as compared to adults is significantly different from 1.0.

Four of the studies listed in Table 2 were omitted from Figure 1 including two that found higher doses in children [22], [23] and two that concluded there were no differences between adults and children [29], [30]. The reasons for this omission are unclear.

Wiat et al. [22] stated that peripheral brain tissue had "... higher exposure with children than with adults." Lu and Ueno [23] conclude that "[t]he induced SAR can be significantly higher in subregions of the child's brain." Both of these quotes were taken directly from Table 2 in Foster and Chou, but their Figure 1 shows results from neither paper.

For at least two papers [17], [19], none of the results in Figure 1 from Foster and Chou corresponds to the summary of findings in their Table 2. In referring to Gandhi and Kang [17], their Table 2 states that the model of the child's head has "peak 1 g SARs that may be up to 50-55% higher compared to the SARs for the larger [adult] model particularly for a PCS frequency of 1900 MHz [High Band]." In contrast, the bar graph in Figure 1 shows the ratio of Child/Adult psSAR_{1g} values <1.0 in both the Low and High Bands.

According to Foster and Chou's Table 2, Hadjem et al. [19] estimated that, for two child head models, the peak 10 gm SAR in the brain "is slightly more significant [higher] than that for the adults one." Their Figure 1 implies that adults have higher dosage rates.

In other words, four studies were described in Table 2, but omitted from Figure 1 and at least two other studies had results reported in Figure 1 that were not consistent with Foster and Chou's own description of the results in Table 2. Our Table 1 suggests additional contradictions between their Table 2 and Figure 1.

Readers who rely on the visual summary of findings in Figure 1 will infer that the majority of studies found higher peak doses in adults. Readers diligent enough to sort through the dense text of Table 2, will reach the opposite conclusion.

More important to the issue at hand is that many of the models cited by Foster and Chou do not take into account differences in the dielectric characteristics of the tissues of children, compared with adults [29], [37]. Without this, models only consider children as small adults. This all but assures that there will be little difference in peak tissue dosage between children and adults, except to the extent that children's smaller heads lead to higher doses in particular anatomical regions of the brain when compared to the larger adult head.

D. ANALYSIS OF STUDY RESULTS

There are two approaches to combining numerical results abstracted from a group of comparable individual studies. The first is to employ the statistical models commonly used in meta-analysis, which pool results of experimental studies mathematically using the standard error of the effect estimates. The modeling studies reviewed by Foster and Chou are not experimental, so their results cannot be pooled using standard meta-analytical techniques.

Results from deterministic models, such as those reviewed by Foster and Chou [3], can be systematically compared based on study characteristics. Steady improvements in model sophistication and dramatic increases in memory and processing speed of computers would lead one to expect more accurate results from more recent models. Of the five studies using sophisticated FACTS models for both adults and children and published in the past ten years, four found higher peak dose rates in children.

Of 22 paragraphs devoted to discussing differences among models, Foster and Chou [3] devote nine to an extended discussion of two models that are 14 and 20 years old. Of the fifteen models published in the past ten years, less than half are mentioned in the discussion.

The reason Foster and Chou chose to criticize the work of a particular author is suggested by their discussion of Penetration Depth, in which they focus almost exclusively on Gandhi's 2002 Figure 3 image of RF-EMR absorption in the brain at different ages. They assert, "A similar set of false-color figures ... showed SAR patterns in all three differently sized head models that extended about the same distance into the head." This is true, as would be expected, because the child's head is smaller (scaled down from an adult's head). This study predated FACTS models, which account for differences in dielectric properties between young and older heads. The apparently controversial message of this image is that RF-EMR penetrates proportionally deeper into the brain of a child than an adult. If, as Foster and Chou assert, absorption is the same in the pediatric and adult brains, then the smaller size of a child's head will guarantee higher doses to tissues deeper in the brain. Much of their argument relies on a paper [27], co-authored by Chou in 2005, a ten-year-old study which relies on a simple, scaled down model of the adult head.

IV. DISCUSSION

In their Discussion, Foster and Chou state: "In summary, simple generalizations found on the Internet about 'kids absorbing more RF energy than adults from cell phones aren't supported by available dosimetry studies.'" The textual summaries of study findings, as provided by Foster and Chou in their Table 2, appear to support exactly the opposite conclusion. These 25 words represent the only part of the Discussion section that refers directly to the topic of the paper—the differences between tissue doses in adults and children.

The remainder of their Discussion argues that none of this is relevant because compliance testing (as discussed in

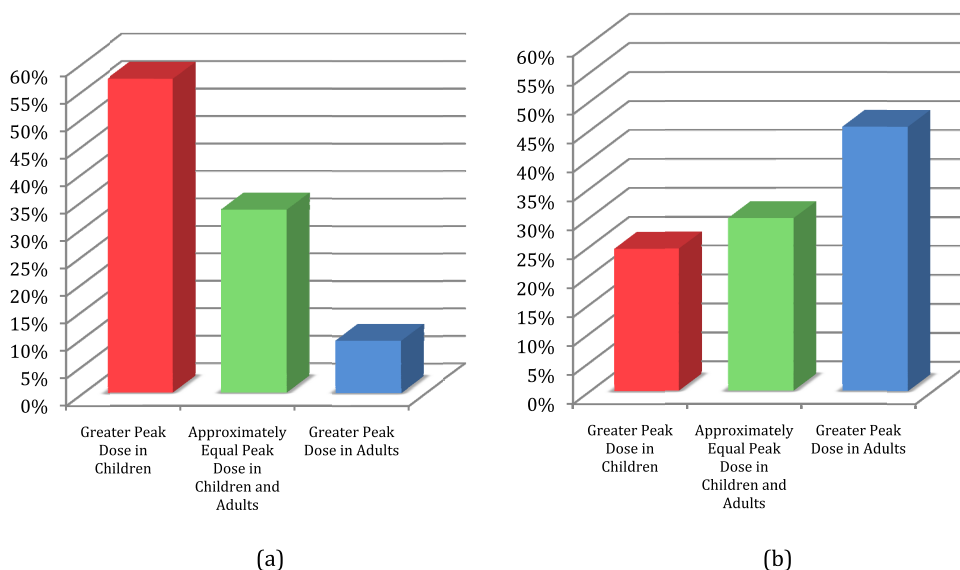


FIGURE 1. (a) Numerical results of original studies as abstracted by Foster and Chou [3]. (b) Summaries of study findings as quoted by Foster and Chou [3].

detail in the Appendix of the current paper) is so susceptible to slight differences in model conditions, particularly phone position, that the calculated tissue doses have no real world relevance. They further argue that worst-case testing grossly overestimates true exposure. These points are, frankly, red herrings and reintroduce the confusion created by the inaccurate title.

Current safety certification of WTDs relies on the Standard Anthropometric Model (SAM), a physical model of an adult head. To draw the conclusion that children have higher doses from a given exposure than adults would both invalidate that certification process and suggest the need for stronger safety standards. This would be expensive and problematic for the telecommunications industry, particularly the makers of WTDs.

The Appendix shows that the current cell phone certification is vastly inferior to an FCC approved FDTD computer simulation certification process that has never been employed to certify phones but is regularly used to evaluate medical devices.

V. CONCLUSION

Foster and Chou [3] review 23 studies that model the penetration and absorption of RF-EMR from cell phones and other MTD's. Figure 1a categorizes the conclusions drawn by the authors of those studies as quoted by Foster and Chou [3]. Based on these summaries, 57% of studies concluded that children had higher peak doses than adults. As shown in Figure 1b, only 25% of the numerical results of these studies as abstracted by Foster and Chou [3] concluded that Children had a higher peak dose.

The chance of this pattern occurring by chance is negligible ($p=0.005$ based on chi-squared test). There are only

two possible alternative explanations for this systematic discrepancy. It is conceivable that the authors of the original studies misrepresented their findings, but the fact that there were many different authors involved and these were all peer-reviewed papers makes this kind of widespread systematic error unlikely. The alternative is that the values abstracted by Foster and Chou do not correctly represent the actual results of these studies.

In response to new evidence documenting children's vulnerabilities to Non-Ionizing Radiation (NIR), the Belgian government has made it illegal to provide a mobile phone to a child age 7 or younger [40]. Similar legislation is under consideration in France, India, Israel and other high-tech nations to reduce exposures to WTDs [41].

Even if children and adults had the same tissue dose for a given exposure, the effects of that same dose on the developing brain of a fetus or young child would almost certainly be greater. Younger brains are faster growing and can therefore be more vulnerable to any toxic agent, whether chemical or physical. In addition, the insulating layer of myelin, which acts to protect nerve cells, is far less developed in the child, the skull is thinner, the immune system is still developing and cells are reproducing far more rapidly than in adults. All of these vulnerabilities increase susceptibility to neurological insult. Neurologists, toxicologists and brain scientists agree that the developing brain is acutely and uniquely sensitive to hazardous exposures [5].

Higher doses in children are even more important in light of evidence that has emerged over the past 15 years suggesting adverse effects from radiofrequency radiation that are completely unrelated to heating. These may include: increased permeability of the blood-brain-barrier (BBB) [42], [43],

genotoxic effects on human cell lines [44], brain cancer [45]–[47], acoustic neuroma [48]–[50], and sperm damage [51]–[53]. In 2013, the World Health Organization's International Agency for Research on Cancer (IARC) classified RF-EMR as a possible (2B) human carcinogen [54].

In light of explosive growth in usage rates and rapid technological change in wireless devices, the American Academy of Pediatrics [55] supports “reassessment of radiation standards for cell phones and other wireless products and the adoption of standards that are protective of children and reflect current use patterns.” The U.S. GAO has also recommended that the FCC reassess its exposure limits in light of new evidence [56].

In sum, the review by Foster and Chou suffers from the following weaknesses.

1. There is no clear protocol specified for the identification of studies and the extraction and summary of data.
2. There are major, systematic discrepancies between the summaries of study results in Foster and Chou's Table 2 and the data presented in their Figure 1.
3. The authors spend almost half of their discussion focusing on papers that are more than a decade old, but say nothing about half of the studies published in the past decade, most of which contradict their primary conclusion.

APPENDIX

RF-EMR EXPOSURE LIMITS AND COMPLIANCE TESTING

In order to give some context to the concerns about compliance testing raised by Foster and Chou [3], we present a brief overview of RF-EMR exposure standard-setting and compliance assessment.

A. RF-EMR EXPOSURE LIMITS

Two RF-EMR exposure limit standards are in general use. The FCC 1996 standard [58] was substantially based on the Institute of Electrical and Electronic Engineers (IEEE) C95.1, 1991 standard with minor input from National Council on Radiation Protection and Measurements (NCRP) Report No. 86. The other, standard primarily used in the European Union (E.U.), was authored by the International Commission on Non-Ionizing Radiation (ICNIRP) [59], [60].

For the general U.S. public the maximum permissible specific absorption rate in any 1 g of tissue (SAR_{1g}) is 1.6 W/kg averaged over 30 minutes. In contrast, the corresponding exposure limit for the general public in the E.U. (ICNIRP) in any 10 gram cube of tissue is 2 W/kg averaged over 6 minutes. The maximum SAR increases as the tissue weight and volume decrease [61], so the E.U. limit allows roughly 2 to 3 times greater exposure than the U.S. limit [21].

B. COMPLIANCE TESTING – TWO FCC APPROVED METHODS

Applicants requiring certification of wireless transmitting devices (WTDs) by the FCC and/or those E.U. agencies adhering to the ICNIRP guidelines are permitted to use either a finite-difference time-domain (FDTD)

Computer Simulation Process, or the Specific Anthropomorphic Mannequin (SAM) physical model to certify that WTDs do not exceed the exposure limit [62].



FIGURE A-1. SAM Phantom. “CTIA” is the Cellular Telecommunications Industry Association. Source: SPEAG Phantom Product Flyer.

C. SAM COMPLIANCE TESTING

A cell phone set to transmit at maximum power is affixed to either side of the mannequin's head (red plastic in Fig. A-1), offset by a distance to simulate the ear. The robotic arm probes SAM to find the highest electric field within any 1 cm³ (1 g) cube, or 10 g, for the 1 and 10 g standards respectively.

SAR is calculated from electric field measurements and the properties of the liquid. Uncertainty in SAR determinations has been stated as $\pm 30\%$ [63].

Modern WTDs can operate simultaneously on different frequencies for both speech and other data, but devices are tested on one frequency at a time.

In 1994, Niels Kuster worked with Motorola colleagues at their Florida research center a submersible electric field probe required for the SAM Certification Process. Shortly thereafter, he created a commercial manufacturing company in Zurich to produce the test system that is now widely used around the world. SPEAG was founded in December 1994 as a spin-off company of the Swiss Federal Institute of Technology (ETHZ) by Kuster and colleagues. Schmid & Partner Engineering was one of the founders of the IT'IS Foundation, and has remained a major sponsor of this research institute [64].

SPEAG is the brand name used by Schmid & Partner Engineering AG for the hardware and software required for the SAM Certification Process. SAM models have been extended to adult phantoms of other body parts, that may be posed. SPEAG also provides FDTD modeling software and services [65].

D. COMPARISON OF SAM AND FDTD COMPLIANCE ANALYSIS

The FDTD Computer Simulation Process is approved for FCC compliance, but according to government websites is not used for WTDs [66], [67]. It is, however, used by the U.S. Food and Drug Administration's (FDA) Center for Devices and Radiological Health (CDRH) to evaluate the

TABLE A-1. Comparison of cell phone certification processes.

Attribute	SAM Process	FDTD Process	Comments
Children's exposures	No	Yes	Male & female, multiple ages
Pregnant women's exposure	No	Yes	1, 3 & 9 months gestation
Female exposure	No	Yes	
Female breast	No	Yes	
Small male exposure	No	Yes	
Large male exposure	Yes	Yes	
Testes exposure	No	Yes	
Dielectric tissue parameters	Average of all head tissues	Specific for each tissue	
3-D resolution	$\sim 1 \text{ cm}^3$	$< 1 \text{ mm}^3$	
Medical implant modeling	No	Yes	
Eye exposure	No	Yes	
Thyroid gland exposure	No	Yes	

safety of medical implants by relying on anatomically based models for persons of varying ages and sizes [68], [69].

Compared with the homogenous fluid-filled SAM head phantom, the FDTD Computer Simulation Process using FDTD Anatomically Correct, Tissue Specific (FACTS) models provides fine-grained resolution of RF-EMR absorption in tissues in any volume within the body, of any age or sex, with any location of the WTD (e.g., adjacent to a pregnant abdomen, or in a trouser pocket in proximity to a testicle).

Table A-1 compares the attributes of the two FCC approved certification processes.

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Microwave Emissions From Cell Phones Exceed Safety Limits in Europe and the US When Touching the Body

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ABSTRACT In our publications, we have shown both from measurements and computer modeling that the specific absorption rate (SAR) reduces by 10%–15% for every millimeter separation of the cell phone on account of rapidly diminishing EM fields in the near-field region of the cell phone antenna. This rapid reduction of SAR depending on the antenna and its location on the handset has been shown, both computationally and experimentally, regardless of the phantom model such as a flat phantom suggested for SAR compliance testing of devices in contact with the body, for a sphere phantom, and for head-shaped models used for SAR compliance testing of cell phones. Unfortunately, our observations in the past were based on SARs of only three cell phones. Expecting that the SARs for cell phones may exceed the safety limits for body contact, cell phone manufacturers have started to recommend that the devices can be used at 5–25 mm from the body even though it is difficult to see how to maintain this distance correctly under mobile conditions. The National Agency ANFR of France recently released the cell phone SAR test data for 450 cell phones that measure 10-g SARs reducing by 10%–30% for each millimeter distal placement from the planar body phantom. Their data corroborate our findings that most cell phones will exceed the safety guidelines when held against the body by factors of 1.6–3.7 times for the European/ICNIRP standard or by factors as high as 11 if 1-g SAR values were to be measured as required by the U.S. FCC.

INDEX TERMS XXXXX.

I. INTRODUCTION

Safety guidelines for radiofrequency (RF) microwave radiation have been proposed by the expert committees in the United States (Institute of Electrical and Electronics Engineers, IEEE) and by the International Committee for non-ionizing radiation protection (ICNIRP) of World Health Organization (WHO) [1], [2] as well as expert committees in Canada, Japan, Australia, etc. While the guidelines suggested by IEEE are followed by the U.S. Federal Communications Commission [FCC] in Washington, DC, the ICNIRP Standard is followed in Europe and many other countries in the world.

The IEEE safety guidelines followed by the FCC prescribe that the microwave emissions of a personal wireless device be limited to ensure that the mass-normalized power absorbed in any part of the body except limbs (specific absorption rate or SAR) does not exceed 1.6 W/kg for any 1 g of tissue

in the shape of a cube [3]. The ICNIRP guideline is more lax and prescribes that the microwave radiation for such wireless devices not create an SAR in any part of the body of more than 2.0 W/kg for any 10 g of tissue. In published literature it has been reported that because of a larger volume for 10 g of tissue the ICNIRP standard will permit radiated powers of cell phones to be 2.5 to 3 times higher than those allowed by the IEEE/FCC standard [4]. The regulatory agency FCC requires that the personal wireless devices marketed in the U.S. meet the IEEE C95.1-1992 standard, thereby requiring lower radiated powers so as not to exceed SAR of 1.6 W/kg in any 1 g of tissue in the shape of a cube for all parts of the body except the limbs (“extremities” such as hands, pinna, or the legs).

II. RECENTLY SUGGESTED CHANGES BY INDUSTRY

Whereas the cell phones are often used held against the ear canal or against the body in shirt or pant pockets and are therefore very close to the body, the cell phone manufacturers

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TABLE 1. SARs in W/kg measured for some representative telephones held against the flat phantom model of the body at manufacturer-suggested distances D and at distances of 5 and 0 mm as for actual use by consumers (taken from ANFR Test Report [10]).

Make	MODEL	SAR at Mfr. Suggested Distance D	SAR (5mm)	SAR (0mm)	Percent increase in SAR for	
					From D to 0mm	From 5 to 0mm
POLAROID	PRO 881A	1.05 (15 mm)	3.63	7.42	13.90%	15.40%
HTC	ONE SV	0.366 (15 mm)	2.256	7.183	22.00%	26.10%
BLACKBERRY	Z 10	0.934 (15 mm)	3.18	6.8	14.20%	16.40%
MOTOROLA	MOTOLUXE	0.254 (25 mm)	2.96	5.86	13.40%	14.60%
ORANGE	NEVA 80 (ZTE BLADE V770)	1.39 (15 mm)	3.62	5.79	10.00%	9.90%
HUAWEI	P9 (EVA-L09)	1.32 (15 mm)	3.18	5.6	10.10%	12.00%
MOTOROLA	RAZR I	0.507 (25mm)	2.27	5.51	10.00%	19.30%
SONY	XPERIA S CITIZY LT26i	0.748 (15 mm)	2.253	5.45	14.20%	19.30%
APPLE	IPHONE 5	0.825 (10 mm)	1.453	5.321	20.50%	29.60%
SAMSUNG	GALAXY S 5 SM-G900 F	0.545 (15 mm)	1.55	3.55	13.30%	18.00%
ECHO	NOTE	1.35 (5 mm)	1.35	4.15	25.20%	25.20%
APPLE	IPHONE 5C	1.11 (5 mm)	1.11	3.11	22.90%	22.95%
SAMSUNG	GALAXY J7 (SM-J710FN)	1.29 (5 mm)	1.29	3.56	22.50%	22.50%

in the last 5-10 years have started to recommend that they be held 5, 10, or 15 up to 25 millimeters from the body. We assume this additional spacing between the cell phone and the body was recommended because of our past publications that these wireless devices will not pass the safety standards when held against the body on account of the very rapidly diminishing EM fields close to radiating antennas [4]–[7], [10]. In spite of the manufacturer recommendations, we find it hard to believe that one can carry out a conversation when the telephone is held up to 25 millimeters away from the ear canal particularly in crowded noisy environments or that these recommended distances can be maintained consistently under mobile conditions without use of a spacer to maintain the suggested distances of 5 to 25 millimeters.

III. RECENT ANFR (FRANCE) CELL PHONE TEST MEASUREMENTS

On June 1, 2017, the National Agency (ANFR) of France released the cell phone SAR test results on hundreds of cell phones that they had been testing at accredited laboratories since January 2012 [9] using a two-sided version of the IEEE-recommended SAM model or a flat body-simulant model. The ANFR tests differed from regulatory tests in that they measured SARs with separation distances D recommended by individual manufacturers as well as placements that were closer at 5 and 0 millimeter to mimic actual use conditions by consumers holding the wireless device against the body, e.g. in their pockets where SARs higher than the safety limits have also been previously reported by us in peer reviewed published literature [10].

The ANFR test program measured the 10 g SAR called for in the European/ICNIRP standard at three positions of use:

the manufacturer-suggested distance D (5, 10, 15, or 25mm) and 5 and 0 mm as for most likely use close to the body (5 mm presumably because of thickness of clothing). A strength of the ANFR results is they have tested 450 cell phones as against our very limited data based on 3 telephones [6], [10]. As the ANFR had tested a large number of cell phones resulting in a very large report [9], we decided to select a limited number of 13 telephones for this paper to illustrate the results. The SARs measured for these 13 selected cell phones are given in Table 1. Shown in this Table is that the telephones give SARs that are within ICNIRP guideline of 2.0 W/kg for manufacturer-suggested distances D (5, 10, 15, or 25 mm), but give SARs that are considerably higher than those of ICNIRP guidelines (by factors of 1.6 to 3.7 times) when the telephones are held against the body to mimic likely actual use conditions. In this context it should be mentioned that the SARs would be even higher by an additional multiplier of 2.5 to 3 or a factor of up to 11 times higher if 1 g values required by the IEEE/FCC standard were measured. All of the 13 selected ANFR-tested devices of Table 1 will not pass the US/FCC safety compliance requirement of 1.6 W/kg for any 1 g of tissue [3]. In the last column of Table 1 we give the calculated increase of SAR per millimeter of reduced spacing for each of the wireless devices from manufacturer-recommended distance D to zero and from 5 mm to zero, respectively. The increase in SAR for each millimeter of proximal placement of the wireless device varies from 10 to 30% which is higher than our previously reported results of 10-15% based on a very limited number—only three cell phones. However the ANFR results do reinforce our additional previously published observations [5] that Standard Anthropomorphic Mannequin (SAM) with tapered plastic

spacer that creates an artificial separation of the wireless device by 6-10 mm will reduce the measured SAR and cannot be trusted as a method for SAR compliance testing. Another thing to observe from the data in columns 4 and 5 is that the SAR is higher by a factor of 2 to 3 for a 5-millimeter closer placement of the wireless device. In [6] we have also proposed this as the reason for a higher SAR for children and for women and men with thinner pinna and skulls resulting in radiating wireless devices being placed closer to the brain in stronger radiated EM fields.

IV. INTERPRETATION OF THE ANFR TEST RESULTS OF TABLE 1

All 13 of the selected telephones of Table 1 fail the SAR requirements mandated by the ICNIRP/European Standard and the US FCC Standard because of the following considerations:

- 1) The ICNIRP guidelines state that the 10-g SAR for conditions of actual use be no more than 2 W/kg and FCC requires compliance with IEEE Standard C95.1-1991 [1] which is set in terms of 1 g SAR of 1.6 W/kg. It has been shown in peer-reviewed published literature [4], [6] that because of the fairly shallow penetration of RF energy coupled to the tissues, the 1 g SAR is typically 2.5-3 times the 10-g SAR.
- 2) For cell phones held against the pinna, the measured 1 or 10 g SAR will also be much higher if SAM had not used the lossless artificial plastic spacer in lieu of the tissue-simulant human pinna. As pointed out in [5] and [6], the tapered plastic spacer artificially separates the radiating cell phone antenna by up to 10 mm additional spacing for the RF coupled regions of the head resulting in underestimation the 1 g and 10 g SAR by a factor to 2-4. This factor of 2-4 higher SAR is also borne out by the ANFR the ANFR measured results in Table 1 where higher values of SAR are reported in columns 3 and 4 that are for separation distances of 15 and 5 mm respectively.

V. CONCLUSIONS

It is important that safety compliance testing be done under realistic conditions of actual use of the cell phones by the present day users. This should include telephones held close to the body at 0 millimeter spacing and against the tissue-simulant pinna rather than a pinna simulated by a tapered plastic spacer. For the latter, phantom models of the actual users such as children and women and men of smaller head sizes should be used rather than the large head size of Army Recruits used for SAM. The children and women are known to have thinner pinna and skulls which results in closer placements by several millimeters of the radiating antennas to the brain. It is not sufficient for manufacturers to start recommending that the microwave radiating devices be held at distances of 5 to 25 millimeters away from the body to reduce measured SAR to meet the safety standards since these suggested distances cannot be maintained correctly without

use of properly attached spacers. Even though ANFR of France has to date released the higher SAR data that does not meet the safety compliance standards when the telephones are held against the body, similar results have also been obtained by independent testing in Canada [11].

Because of the increasing popularity of wireless phones all over the world with use by over 90-95% of populations, it is important that the regulatory agencies in various countries define correct conditions for SAR testing that will cover a majority of users including children.

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The author would like to thank the contributions of Dr. Marc Arazi of Paris, France, in providing the English translation of the fairly large ANFR TEST Report [9] and Ms. Theodora Scarato in carefully preparing a shortened version of the large ANFR report with data on 450 tested devices into columns 1-5 of Table 1 for 13 selected telephones for illustrative purpose.

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Authors' photographs and biographies not available at the time of publication.

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Testing; Pong Research Corporation Reply Comments, Nov. 17. 2013

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure)	
Limits and Policies)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	

REPLY COMMENTS OF PONG RESEARCH CORPORATION

Pong Research Corporation ("Pong") submits these reply comments in response to the Federal Communications Commission's ("FCC") First Report And Order, Further Notice of Proposed Rule Making, and Notice Of Inquiry ("NOI") in the above-captioned dockets. Most of Pong's reply comments relate to the NOI portions of these proceedings.

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In its initial comments in response to the NOI¹, Pong (and other commenters) advanced several basic premises: *viz.* that (1) current FCC guidelines for Specific Absorption Rates (“SAR”)² particularly underestimate children’s exposure to RF energy and, so, should be modified sufficiently to protect them; (2) FCC testing protocols likewise understate consumers’ exposure to RF energy generally due to proximity allowances that fail to reflect normal use, and should be changed accordingly; (3) device certification processes should account for accessories, specifically cases, that have become common today, inasmuch as extant antiquated standards from 1997 already address less prevalent accessories like belt clips and holsters; (4) consumers should receive more accessible and complete information regarding RF exposure, including at point of sale; and (5) the FCC should encourage consumer awareness of RF exposure risks and related precautionary measures, and not relax existing safety standards.

Several commenters in these proceedings, however, have mischaracterized the current state of science with respect to human RF energy exposure, in an effort to undermine these themes—based in part upon the fatally flawed notion that existing RF safety standards incorporate a “50-fold” safety factor. In these commenters’ views, *it does not matter that* (1) children’s exposure to RF energy exceeds that of adults, *or that* (2) consumers normally use portable devices proximate to, or even at “zero distance” from, their bodies, *or that* (3) device certification processes fail to account for cases that, concededly, may increase SAR (not to mention decrease performance), *or that* (4)

¹ Filing of Pong Research Corporation in Docket 13-84 dated September 3, 2013, <http://apps.fcc.gov/ecfs/document/view?id=7520940737> (“Pong Comments”).

² See *In re Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, Release No. 96-326, 11 F.C.C.R. 15123, 15124 (1996). The FCC therein adopted the current radio-frequency (“RF”) radiation exposure standards that establish a maximum SAR of 1.6 watts per kilogram (1.6 W/kg) for spatial peak SAR averaged over any 1 gram of tissue. See 47 C.F.R. §2.1093(d)(2). All portable devices distributed or sold in the United States must comply with this limit.

consumers may be unaware of RF exposure risks and precautionary measures, *or that* (5) existing RF safety standards might be relaxed, on the basis of flawed scientific assumptions, among them that the putative margin of error is 50 times a level of any “real” risk.

I. SOME COMMENTERS MISCHARACTERIZE THE STATE OF SCIENCE TODAY WITH RESPECT TO RF EXPOSURE FROM WIRELESS DEVICES.

A. Background: The Government Accountability Office (“GAO”) Report

Some commenters have tacitly suggested—based on 20-year-old observations, and mischaracterizing the state of science today—that cell phones are safe to a scientific certainty. These parties hope that the FCC will so conclude for them (as they refuse to state it themselves), determine that changes to the testing guidelines are unnecessary (even to improve accuracy), decline adequately to inform consumers (so as not to “alarm” them), and close this proceeding (as essentially unnecessary). The FCC, however, should view this posture for what it is: a request that the FCC ignore its public interest obligations.

A GAO Report released August 7, 2012 (the “GAO Report”)³ urged the FCC to update its portable device radiation exposure and testing guidelines. The GAO concluded that current FCC RF exposure standards—in place since 1997 (some 4 years before the first smartphones became commercially available)—“*may not reflect the latest research,*”⁴ “*may not identify maximum exposure [to radiation] in all possible usage*

³ GAO Report, *Exposure and Testing Requirements for Mobile Phones Should Be Reassessed*, GAO-12-771, July 2012, <http://www.gao.gov/assets/600/592901.pdf>.

⁴ *Id.*, at Highlights page, emphasis added.

*conditions,”*⁵ and fail to test for portable device use against the body that “*could result in RF energy exposure higher than the FCC limit.*”⁶ GAO further noted, “By not formally reassessing its current limit, FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure.”⁷

GAO further noted the lack of certainty and possible risks associated with RF energy from wireless devices:

In 2001, we reported that [the United States Food and Drug Administration (“FDA”)] and others had concluded that research had not shown RF energy emissions from mobile phones to have adverse health effects, but that **insufficient information was available to conclude mobile phones posed no risk.**

Following another decade of scientific research and hundreds of studies examining health effects of RF energy exposure from mobile phone use, **FDA maintains this conclusion.** FDA stated that while the overall body of research has not demonstrated adverse health effects, **some individual studies suggest possible effects. Officials from [the National Institutes of Health (“NIH”)], experts we interviewed, and a working group commissioned by [International Agency for Research on Cancer (“IARC”)]—the World Health Organization’s agency that promotes international collaboration in cancer research—have reached similar conclusions.** For example, in May 2011 IARC classified RF energy as “possibly carcinogenic to humans.”⁸

The record in this proceeding demonstrates that the FCC’s current guidelines:

1. Do not accurately measure true radiation absorption by children, and that children absorb far greater levels of RF energy than adults;⁹

⁵ *Id.*, emphasis added.

⁶ *Id.*, emphasis added.

⁷ *Id.*

⁸ *Id.*, at pages 6-7, emphasis added.

⁹ See Section II below.

2. Allow testing at up to 25 cm distance in body-worn configuration and thus do not accurately measure true radiation absorption by users, including children so, accordingly, the proximity requirements for testing should be modified to include a “zero spacing” requirement;¹⁰
3. No longer accurately reflect how consumers actually use devices, given that—in contrast to the FCC’s 1997 guidelines that required testing of devices with belt clips and holsters in body-worn configuration—most consumers today use cases, which the record in this proceeding demonstrates can substantially increase SAR;¹¹
4. Fail to provide consumers with adequate notice of precautions they could take to minimize RF exposure; and
5. Do not adequately account for recent studies that have shown health impacts associated with RF energy, including non-thermal effects.¹²

B. The Laws of Physics and RF Exposure

These observations are grounded in part on the “inverse square law” of physics that, in the context of radiation exposure, means the intensity of RF radiation is inversely proportional to the square root of the distance from its source.¹³ Thus, for example, at a theoretical level a given constant of radiation is 6.25X as intense at 1 cm as at 2.5 cm,

¹⁰ See Section III below.

¹¹ See Section IV below.

¹² See Pong Comments, at Appendix A and footnote 81. See also Filing of Environmental Working Group (“EWG”) in Docket 13-84 dated September 2, 2013, at pages 3-9, available at: <http://apps.fcc.gov/ecfs/document/view?id=7520941812> (“EWG Comments”), and Filing of American Academy of Pediatrics (“AAP”) dated August 29, 2013 in Docket 13-84, available at: <http://apps.fcc.gov/ecfs/document/view?id=7520941318> (“AAP Comments”).

¹³ Cf. FCC Office of Engineering & Technology (“OET”), *Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields*, OET Bulletin 56 (4th ed.), August 1999, at page 21 (noting that “[a]s with all forms of electromagnetic energy, the power density from a cellular or PCS transmitter decreases rapidly (according to an inverse square law) as one moves away from the antenna”).

and 25X as intense at 0.5 cm as at 2.5 cm.¹⁴ *At 0.25 cm, or nearer to “zero distance”—the level at which the GAO noted may more accurately reflect “normal operating positions or conditions”—the intensity is 100X that of the 2.5 cm distance at which original equipment manufacturers (“OEMs”) can test their portable devices.*¹⁵

Users may experience substantially higher SAR levels in “real world” conditions, because the cell phone radiation that consumers’ heads and bodies absorb occurs in the so-called “near field” (not just at “zero distance”) of the antenna.¹⁶ The Occupational Health and Safety Administration (“OSHA”) explained the consequent implications of the inverse square law for consumers in the context of near field RF exposures, as follows:

As you might have guessed, the reactive near-field region has another surprise in store for you. In this reactive region, not only is the [electromagnetic or “EM”] wave being radiated outward into space, but also there is a “reactive” component to the EM field. Very close to the antenna, energy of an unknown amount is held back and is stored very near the antenna surface. This reactive component can be the source of confusion and danger in attempting measurements in this region. **In other regions the power density is inversely proportional to the square of the distance from the antenna. In the vicinity very close to the antenna, the energy level can rise dramatically with only a small additional movement**

¹⁴ The formulas for this simple math follow the basic principle of the inverse square law. So (rounding certain results to 2 decimal places), $1/(.5)^2=4$; $1/(1)^2=1$; $1/(2.5)^2=0.16$; and so forth. Comparing results, 0.16 is 6.25X less than 1 and 25X less than 4. In the ultimate example of this paragraph that posits a distance of 0.25 cm, $1/(.25)^2=16$ or 100X more than 0.16 (the result at 2.5 cm).

¹⁵ While allowing up to 2.5 cm, the FCC’s OET recommends 1.5 cm separation. Cf. *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, Supplement C (Edition 01-01) to Bulletin 65 (“Supplement C”), June 2001, at page 41 (explaining that “[a] separation distance of 1.5 cm between the back of a device and a flat phantom is recommended for body-worn compliance . . . [and that other] separation distances may be used, but they should not exceed 2.5 cm.”)

¹⁶ See, e.g., Supplement C, at page 9 (explaining that “[t]he user of a handset is normally in the reactive near-field region of the antenna where the electromagnetic field is mostly non-propagating . . . [and] RF energy is scattered and attenuated as it propagates through the body tissues”).

towards the antenna. This energy can be very dangerous (even hazardous) to both humans and measurement equipment where high powers are involved.

CAUTION: When the radiating dimensions of the antenna are *much smaller* than one wavelength and/or the frequency is low . . . , it is especially important to be aware of the **POTENTIALLY HAZARDOUS REACTIVE FIELDS WHICH MAY EXIST IN THE REACTIVE NEAR-FIELD.** Exercise extreme caution for both your safety and the equipment when making near-field measurements **As you move nearer to the antenna in the reactive near-field, the energy can increase much quicker than what is computed by the inverse-square law.** Some electromagnetic energy is stored in the near-field in the vicinity of the antenna that can be an unsuspected source of dangerous energy. This “reactive field” energy is especially dangerous with high power systems. The closer to the radiating source you get, the more caution should be exercised.¹⁷

In simplest terms, then, the precise amount of RF radiation exposure a consumer might experience from the near field of a cellular antenna is, for all practical purposes (to quote OSHA), “*unknown*.”¹⁸

¹⁷ Occupational Safety and Health Administration, Cincinnati Technical Center, *Electromagnetic Radiation: Field Service Memo—Electromagnetic Radiation and How it Affects your Instruments*, May 20, 1990, Section VI, emphasis added.
https://www.osha.gov/SLTC/radiofrequencyradiation/electromagnetic_fieldmemo/electromagnetic.html#section_6.

¹⁸ It is important to note that OSHA, in its 1990 statement, did not propose any particular human exposure standard—but merely described then- and still-established scientific principles concerning the behavior of “near” RF fields.

C. The “50-Fold” Safety Factor is a Myth, and in Fact Actual Exposure May be Far Higher

Against this backdrop—and in the face of the GAO Report, the NOI, and established science regarding how RF fields behave—some commenters suggest that consumers’ actual RF exposures might safely exceed the FCC’s safety standard of 1.6 W/kg SAR *by a factor of at least 50 times*, and on that basis any changes to the FCC’s testing guidelines, even if they improve accuracy, and better inform consumers, are essentially unnecessary. One commenter, for example, touts this alleged “50-fold” safety factor (relative to the FCC’s standard of 1.6 W/kg) at least 16 separate times, and takes the extraordinary view that the FCC’s standard is *not a safety matter at all*, but simply a construct for optimal portable device use and operation:

Nor does any evidence suggest that SAR values that exceed Commission limits necessarily imply unsafe operation, or that lower SAR values imply “safer” operation. In this context, CTIA agrees¹⁹ that exceeding the SAR limit “should not be viewed with significantly greater concern than compliant use,” in part due to the fifty-fold safety factor incorporated into the existing RF emission standards. **CTIA considers Supplement C’s body-worn device separation requirement an issue of proper use and operation, as opposed to one of health and safety.**²⁰

But repeatedly stating something that is false does not make it true. Further, this revisionist view notwithstanding, industry representatives will not state unqualifiedly that

¹⁹ CTIA here claims to “agree” with, and so cites ¶251 of, the NOI that (of course) took no such conclusive view. Filing of CTIA—The Wireless Association dated September 3, 2013 in Docket 13-84 (“CTIA Comments”), <http://apps.fcc.gov/ecfs/document/view?id=7520941701>, at page 56, footnote 252.

²⁰ *Id.*, at page 56, footnotes omitted. See Filing of CEA in Docket 13-84 dated September 3, 2013, at pages 11-12, <http://apps.fcc.gov/ecfs/document/view?id=7520941397> (“CEA Comments”).

“cell phones are safe.”²¹ Dane Snowden, Vice President of External and State Affairs of CTIA, for example, has testified:

I want to be very clear. **Industry has not said once, [not] once, that cell phones are safe.** The federal government, the various inter-agency working groups, have all said that it’s [sic] safe.²²

Instead commenters posit a syllogism in which **they** voice the premises that:

- Things that are unsafe evidence harm to a scientific certainty.
- Portable devices have not yet evidenced harm to a scientific certainty.

but hope that **the FCC** will state the conclusion . . .

- Therefore, portable devices are safe.

This logic is flawed.

First, “not unsafe” (the logical conclusion to this construct) does not necessarily mean “safe,” and “safe” (as defined by the FCC in this context) may lack any meaning whatsoever in light of the current proceedings. Commenters have misplaced their reliance on the FCC’s circuitous characterization that “any cell phone at or below . . . SAR levels [of 1.6 W/kg] (that is, any phone legally sold in the U.S.) is a ‘**safe**’ phone, as measured by [current testing] standards.”²³ So “safe” is detached from any notion that consumers would commonly understand, but rather merely means “at or below SAR of 1.6 W/kg as measured under 1997 FCC test protocols.” Yet the GAO Report called these

²¹ The filings by CEA, CTIA, and other industry groups are devoid of any such straightforward statement.

²² Testimony of Dane Snowden, Vice President of External and State Affairs CTIA, before City Council of Burlingame, Vermont, September 20, 2010. <http://www.youtube.com/watch?v=s5yGTZq06zQ>.

²³ <http://www.fcc.gov/encyclopedia/specific-absorption-rate-sar-cellular-telephones>, emphasis added.

very standards into doubt, which remain at issue in the NOI.

Second, commenters explain away the substantial scientific evidence of potential harm to consumers from RF radiation exposure with the notion that the “nature of scientific inquiry means that there can never be absolute proof of the negative, i.e., proof of safety; the most science can do is just to accumulate more and more data showing a lack of harm.”²⁴ But the government mandates warnings in all sorts of contexts in which products, though “not unsafe,” may pose risks to consumers.²⁵ The “industry” (to adopt one commenter’s term), however, eschews any such requirements regarding RF radiation exposure.²⁶

Third, the supposed “50-fold” safety factor inherent in RF exposure limits lacks any practical application or substantial scientific underpinning, although some commenters state this notion as an absolute.²⁷ On the one hand, this theoretical cushion depends upon notions of proximity separation that do not account for (1) “unknown” amounts of RF radiation in the near field, (2) true absorption at closer distances by virtue of the inverse square rule, or (3) how consumers actually use portable devices. One

²⁴ CTIA Comments, at page 49.

²⁵ As one example, nobody would consider automobiles “unsafe”—and, indeed, if any particular model were deemed unsafe, it could not be sold in United States commerce. Yet the Department of Transportation and other competent authorities require all sorts of devices (like seat belts, air bags, and so on) and prescribe consumer advisories—and Congress has passed federal, or otherwise enabled state, laws requiring the use of such “safety” techniques. *See also* pages 51-53, *infra*, concerning the example of how FDA regulates microwave ovens.

²⁶ *See, e.g.*, CEA Comments, at page 7 (stating that the FCC “should not require disclosure of maximum SAR information for approved devices”) and CTIA Comments, at page 42 (insisting that “a mandatory RF advisory would, at the very least, confuse consumers because the very existence of such an advisory would be perceived as a warning, and would contradict **the federal government’s message that wireless phones are safe**”) (emphasis added).

²⁷ *See, e.g.*, *Cell Phone Health Facts*, CTIA (claiming that “[t]he FCC’s safety standards include a 50-fold safety factor”) http://www.cellphonehealthfacts.com/key_things_to_know.html. CTIA’s repeated references to “safety standards” belie CTIA’s claim that the FCC’s RF exposure regulations are matters “**of proper use and operation, as opposed to one[s] of health and safety.**”

commenter's claim—that “[a]s between a zero-spacing restriction and the existing proximity restriction, . . . the latter more accurately mimics real-world SAR levels and usage,”²⁸—is manifestly erroneous, as the GAO itself has determined.²⁹ Consumers customarily carry their devices on their persons in body-worn configurations directly against their bodies, and the FCC should simply take administrative notice of this point. As if further evidence were needed on the matter, the recent proliferation of “wearable” devices—that, by definition, touch or remain at near “zero distance” to the person for extended periods of time—proves the point.³⁰

On the other hand, the calculus for the “50X” safety margin depends on a divisor of 1.6 (W/kg) and a subject “Specific Anthropomorphic Mannequin” (“SAM”) the size of a 6’2” 200-pound United States Marine.³¹ But recent research has observed biological effects from RF exposure at 0.022 W/kg—well below the current 1.6 W/kg standard.³²

²⁸ CTIA Comments, at page 57.

²⁹ GAO Report, *Highlights* section.

³⁰ Many such “wearable” devices themselves operate solely on Wi-Fi and Bluetooth connections, but nonetheless depend on smartphones—that operate on cellular signals—for essential functionality. Smartphones in these configurations will typically remain in “body-worn” configuration for prolonged time periods. Examples of such devices include so-called “smart watches” like the Samsung “Galaxy Gear.” <http://www.samsung.com/us/guide-to-galaxy-smart-devices/galaxy-gear.html>. Google Inc. has famously introduced “Google Glass”—innovative eyeglasses (available on a limited basis) that display full smartphone functionality privately to the wearer and that operate via voice commands—that now features prescription lenses, and so encourages consumers to wear them constantly. See <http://www.google.com/glass/start/>. The stated SAR for Google Glass is 1.42 W/kg. SAR Evaluation Report for Glass Model XEB, FCC ID: A4R-X1, Report #13U14955-5A, prepared for Google Inc. by ULCCS, April 15, 2013, at page 27.

³¹ Leading researcher Om P. Gandhi notes, for example, “[T]he existing cell phone certification process uses a plastic model of the head called the Specific Anthropomorphic Mannequin (SAM), representing the top 10% of U.S. military recruits in 1989 and greatly underestimating the [SAR] for typical mobile phone users, especially children” Gandhi, O.P. et al., and *Exposure Limits: The Underestimation of Absorbed Cell Phone Radiation, Especially in Children*, *Electromagnetic Biology and Medicine*, Early Online, 1-18 (2011).

³² Levitt, B.B. and Lai, H., *Biological Effects from Exposure to Electromagnetic Radiation Emitted by Cell Tower Base Stations and other Antenna Arrays*, *Environmental Reviews*, November 5, 2010, 18(NA): 369-395, 10.1139/A10-018, <http://www.nrcresearchpress.com/doi/pdf/10.1139/A10-018>. This study includes more than 100 citations, 80% of which showed biological effects at SAR levels below 1.6 W/kg. Out of the 56 papers Dr. Lai examined, 37 provided the SAR of exposure and indicated biological effects at an average 0.022 W/kg. *Id.*

As well, the SAR for a 10-year old is up to *153% higher* than the SAR for the SAM model and—when electrical properties are considered—“a child’s head’s absorption can be over two times greater, and absorption of the skull’s bone marrow can be *ten times* greater than adults.”³³ The origins of the 1.6 W/kg standard for spatial peak SAR, finally, is arbitrarily derived.³⁴

Today’s SAR standard of 1.6 W/kg derives from tests on lab rats conducted in 1980. In each study, SAR of approximately 4.0 W/kg with only 30 to 60 minutes of whole body exposure disrupted animal behavior. The American National Standards Institute (ANSI) determined that “behavioral effects, though reversible, might lead to irreversible injury during chronic exposures.”³⁵ On that basis, ANSI in 1982 discretionarily incorporated a **10-fold** margin of error (to 0.4 W/kg—averaged over 6 minutes) for whole body human exposure, equating to 8 W/kg for spatial peak SAR over any 1 gram of tissue, between 300 kHz and 100GHz in so-called “uncontrolled” environments applicable to the general population (as opposed to “controlled” workplace environments in which a higher standard might apply).³⁶ ANSI acknowledged, however, that the SAR standard omitted various factors important to assessing health risks, including “modulation frequency” and “peak intensity.”³⁷ The Institute of Electrical and Electronics Engineers (IEEE), accordingly, discretionarily (again), reduced the 8 W/kg

³³ Gandhi, O.P., emphasis added. See footnote 31, *supra*.

³⁴ *Id.*, at page 35.

³⁵ See ANSI, *Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz*, ANSI C95-1982 (New York: The IEEE, Inc.), at page 14.

³⁶ As Gandhi notes, however: “Because the resultant Specific Absorption (SA) is identical for the general population in an uncontrolled environment, as it is for workers in a controlled environment (0.08 W/kg*30 min = 0.4 W/kg*6 min), the ‘larger safety factor’ for the general population is **non-existent**.” Gandhi, O.P., at page 3, emphasis added.

³⁷ ANSI, at page 14. A resonant frequency of 70 MHz, for instance, “results in an approximate sevenfold increase of absorption relative to that in a 2450 MHz field.” *Id.*, at page 12.

standard for peak spatial SAR by a **factor of 5** to 1.6 W/kg in 1992. The claimed “**50-fold**” safety factor that some commenters cite as a scientific absolute, owes to these arbitrary reductions. Neither IEEE nor, assuredly, ANSI is a medical, biological, or public health institution. In 1992, the wireless industry was in its infancy and, in the United States, only about 2% of the population had cell phones.³⁸ The FCC adopted the IEEE standard in 1996 although—its declarations that cell phones are “safe” notwithstanding—the FCC observed in the NOI that “[s]ince the Commission is not a health and safety agency, **we defer to other organizations and agencies with respect to interpreting the biological research necessary to determine what levels are safe.**”³⁹

The foregoing background shows that, rather than a “50-fold” safety factor, consumers’ exposure to RF radiation in the “real world” may far exceed any, even more liberal, margin of error. At proximities that reflect “normal operating positions and conditions,” the inverse square law proves that RF intensity can reach 100X that of the 2.5 cm distance at which OEMs can test their portable devices. When one accounts further for uncertainties in what OSHA calls the “reactive near-field,”⁴⁰ SAR “can increase much quicker than what is computed by the inverse-square law.”⁴¹ And, anomalies of the 6’2” 200-pound SAM model aside, real SAR for children and vulnerable populations “can be over two times greater, and absorption of the skull’s bone marrow can be ten times greater than adults.”⁴² **These combined variables indicate that, in fact, the FCC’s SAR standard for vulnerable populations may be—rather than 50**

³⁸ See, e.g., <http://www.birgit.muehlenhaus.com/education/thesis/chapter5.pdf>, at page 77 (noting that in 1991 there were 6.38 million users in the U.S.).

³⁹ NOI, Section 6, emphasis added.

⁴⁰ See OSHA, footnote 17, *supra*.

⁴¹ *Id.*

⁴² Gandhi, O.P., at page 35.

times too low—as much as 1,000 times or more too high.

Commentators nonetheless suggest that cell phones are safe to a scientific certainty, *even at levels of radiation that are up to 50 times the FCC's current limits*. For example, CTIA states that the standards are “[b]acked by scientific evidence and set at a level 50 times below the threshold at which biological impacts are observed.”⁴³ The Telecommunications Industry Association (“TIA”) similarly claims that the “[GAO] Report that found that the FCC guideline is ‘a fiftieth’ of this SAR threshold for an adverse health effect and therefore no additional margin for precaution is needed.”⁴⁴ Of course, if one assumes, however erroneously, that cell phones are safe to a scientific certainty—even at up to 50X current FCC exposure limits—it does not matter that the testing regime might fail to simulate how consumers actually use devices under *normal operating positions or conditions*, since consumers inhabit a sort of buffer zone that extends 50X from the FCC’s exposure limits.

Though inaccurate and illogical, this line of reasoning appears to reflect some commenters’ arguments concerning proximity limits within the SAR testing program. For example, though the GAO specifically noted that the FCC’s regulations might understate true radiation absorption by users, TIA contends that “given the ample safety factor in the standard—those current procedures are sufficient for assuring consumer safety,”⁴⁵ and “there is no basis for concern about a health risk from the current allowable spacing.”⁴⁶ CTIA mirrors this view: “Adopting a ‘zero-spacing’ testing protocol is not

⁴³ CTIA Comments, at page 2.

⁴⁴ See Filing of the Telecommunications Industry Association dated September 3, 2013 in Docket 13-84 (“TIA Comments”) <http://apps.fcc.gov/ecfs/document/view?id=7520941840>, at page 19.

⁴⁵ *Id.*, at page 24.

⁴⁶ *Id.*, at page 25.

appropriate at this time. . . . In this context, CTIA agrees that exceeding the SAR limit ‘should not be viewed with significantly greater concern than compliant use,’ in part due to the fifty-fold safety factor incorporated into the existing RF emission standards.”⁴⁷

Again, *these commenters essentially hold that the FCC’s prescribed testing methods can remain inaccurate, since cell phones are safe, even at up to 50X the present limit.* This notion, followed to its logical end, leads to the implausible conclusion that *the FCC testing regime is not necessary at all.*

Of course, apart from being unhinged from the practical laws of physics (including the inverse square law and uncertainties of near-field measurements), this argument further breaks down because—in fact—cell phones have *not* been conclusively determined to be safe to a scientific certainty. In fact, a number of recent studies show health impacts from cell phone radiation. As GAO stated, “Insufficient information was available to conclude mobile phones posed no risk, [and] FDA stated that while the overall body of research has not demonstrated adverse health effects, some individual studies suggest possible effects. Officials from NIH, experts we interviewed, and a working group commissioned by IARC—the World Health Organization’s agency that promotes international collaboration in cancer research—have reached similar conclusions. For example, in May 2011 IARC classified RF energy as “possibly carcinogenic to humans.”⁴⁸

⁴⁷ CTIA Comments, at page 56.

⁴⁸ GAO Report, at pages 6-7.

D. Current Science on Biological and Health Effects of RF Exposure

Recent studies have reported adverse biological and health effects from low-level non-ionizing RF energy exposure from cell phones. For example, the 13-country “Interphone” study reported a 40% increased risk of a certain type of brain tumor called “glioma” from an average of 27 minutes of daily cell phone use over 10 years; a 2013 study involving 790,000 women in the United Kingdom found a possible increased risk of acoustic neuroma in women who had used a cell phone for more than 5 years compared to women who never used a cell phone, and the risk of acoustic neuroma increased with increasing duration of cell phone use⁴⁹; a 2011 study published in the *Journal of the American Medical Association* found that just “50-minute cell phone exposure was associated with increased brain glucose metabolism in the region closest to the antenna”⁵⁰ (a non-thermal effect); and a 2012 Yale University School of Medicine study conducted in mice concluded that exposure to radiation from cell phones during pregnancy affects the brain development of offspring, potentially leading to hyperactivity.⁵¹ Appendix A of our initial comments in this proceeding summarizes the numerous studies showing biological and health effects from cell phone radiation.⁵²

⁴⁹ Benson et al, for the Million Women Study Collaborators, 2013.

⁵⁰ Volkow, N. et al., *Effects of Cell Phone Radiofrequency Signal Exposure on Brain Glucose Metabolism*, Journal of the American Medical Association (JAMA), February 23, 2011, Vol. 305, No. 8: 808-813, available at <http://jama.jamanetwork.com/article.aspx?articleid=645813>. Cf. Lai, H. and Hardell, L., *Cell Phone Radiofrequency Radiation Exposure and Brain Glucose Metabolism*, JAMA, February 23, 2011, Vol. 305 No. 8 (commenting that in the Volkow study “brain areas that showed an increase in glucose metabolism were quite distant from the contact area [and, thus,] it is not likely that the effects observed were caused by heating.”)

⁵¹ See Pong Comments, at page 34, footnote 81.

⁵² See *Biological and Health Effects of Cell Phone Radiation/Scientific Literature and References*, Pong Comments, Appendix A. For additional studies of health impacts and cell phone radiation, see EWG Comments, at pages 7-9.

Experts from Yale University recently surveyed the latest scientific studies, as well as other data, on these topics.⁵³ The following charts correlate these studies to certain associated biological effects from RF radiation exposure.

Table 2. RF Radiation from Cell Phones and Cancer: Conclusions of Peer-Reviewed Review Studies		
AUTHOR	FINDINGS	AFFILIATION
Ahlbom A et al. (2009) ³⁴	"...the studies published to date do not demonstrate an increased risk within approximately 10 years of use for any tumor of the brain or any other head tumor.... For slow-growing tumors ...the absence of association reported thus far is less conclusive because the observation period has been too short."	International Commission for Non-Ionizing Radiation Protection
Khurana VG et al. (2009) ³⁵	"...there is adequate epidemiologic evidence to suggest a link between prolonged cell phone usage and the development of an ipsilateral brain tumor."	Australian National University
Han YY et al. (2009) ³⁶	"Some studies of longer term cell phone use have found an increased risk of ipsilateral AN [acoustic neuroma]."	Center for Environmental Oncology—University of Pittsburgh Cancer Institute
Kohli et al. (2009) ³⁷	"The evaluation of current evidence provided by various studies to suggest the possible carcinogenic potential of radiofrequency radiation is inconclusive."	Department of Internal Medicine, Government Medical College and Hospital, India
Myung et al. ³⁸	"...there is possible evidence linking mobile phone use to an increased risk of tumors from a meta-analysis of low-biased case-control studies."	National Cancer Control Research Institute, National Cancer Center, Korea
Croft et al (2009) ³⁹	"There are reports of small associations between MP-use ipsilateral to the tumour for greater than 10 years, for both acoustic neuroma and glioma, but the present paper argues that these are especially prone to confounding by recall bias."	Australian Centre for Radiofrequency Bioeffects Research
Abdus-Salam et al. (2008) ⁴⁰	"...published research works over several decades including some with over ten years of follow up have not demonstrated any significant increase in cancer among mobile phone users. However, the need for caution is emphasized as it may take up to four decades for carcinogenesis to become fully apparent."	Department of Radiotherapy, College of Medicine, University of Ibadan, Ibadan, Nigeria.
Kundi (2008) ⁴¹	"The overall evidence speaks in favor of an increased risk, but its magnitude cannot be assessed at present because of insufficient information on long-term use."	Institute of Environmental Health, Medical University of Vienna, Vienna, Austria

⁵³ See Wargo, J., Taylor, H. et al., *Cell Phones—Technology, Exposures, and Health Effects*, Environment & Human Health, Inc., 2012, available at <http://www.ehhi.org/reports/cellphones/>.

Author	Year	Species	Frequency	SAR	Exposure Duration	Effect
Narayan SN et al. ⁵²	2010	Rat	900 MHz – 1.8 GHz	NS	50 missed calls (45 sec.); within 1 hr per day for 4 weeks	Altered passive avoidance behavior and hippocampal morphology
Fragopoulou AF et al. ⁵³	2010	Mouse	900 MHz	0.41 W/kg – 0.98 W/kg	1 hr 55 min. for the first 3 days; 3 hr 45 min. on the fourth day's probe trial	Deficits in consolidation and/or retrieval of learned spatial information
Daniels WM et al. ⁵⁴	2009	Rat	840 MHz	NS	Continuous for 3 hrs/day from day 2 to day 14 after birth	Decreased locomotor activity, increased grooming and a tendency toward increased basal corticosterone levels
Nittby H et al. ⁵⁵	2008	Rat	900 MHz	0.0006 W/kg – 0.06 W/kg	2 hrs/week for 55 weeks	Reduced memory functions after GSM exposure (P = 0.02)
Eliyahu I et al. ⁵⁶	2006	Human	890.2 MHz	NS	Continuous for 2 hours	Exposure to left side of brain slowed left-hand response time
Maier R et al. ⁵⁷		Human	902 MHz	NS	Continuous for 50 min	Pulsed EMF exposure impaired cognitive performance

Author	Year	Effect Noted
Deluliis et al. ⁶²	2009	"RF-EMR in both the power density and frequency range of mobile phones enhances mitochondrial reactive oxygen species generation by human spermatozoa, decreasing the motility and vitality of these cells while stimulating DNA base adduct formation and, ultimately, DNA fragmentation. These findings have clear implications for the safety of extensive mobile phone use by males of reproductive age, potentially affecting both their fertility and the health and well-being of their offspring."
Salama N et al. ⁶³	2009	"Low intensity pulsed radiofrequency emitted by a conventional mobile phone kept in the standby position could affect the testicular function and structure in the adult rabbit."
Agarwal A et al. ⁶⁴	2009	"Radiofrequency electromagnetic waves emitted from cell phones may lead to oxidative stress in human semen. We speculate that keeping the cell phone in a trouser pocket in talk mode may negatively affect spermatozoa and impair male fertility."
Agarwal A et al. ⁶⁵	2008	"Use of cell phones decrease[s] the semen quality in men by decreasing the sperm count, motility, viability, and normal morphology. The decrease in sperm parameters was dependent on the duration of daily exposure to cell phones and independent of the initial semen quality."
Yan JG et al. ⁶⁶	2007	"Rats exposed to 6 hours of daily cellular phone emissions for 18 weeks exhibited a significantly higher incidence of sperm cell death than control group rats through chi-squared analysis.... [A]bnormal clumping of sperm cells was present in rats exposed to cellular phone emissions and was not present in control group rats. These results suggest that carrying cell phones near reproductive organs could negatively affect male fertility."
Wdowiak A et al. ⁶⁷	2007	"In the analysis of the effect of GSM equipment on the semen it was noted that an increase in the percentage of sperm cells of abnormal morphology is associated with the duration of exposure to the waves emitted by the GSM phone. It was also confirmed that a decrease in the percentage of sperm cells in vital progressing motility in the semen is correlated with the frequency of using mobile phones."
Panagopoulos DJ et al. ⁶⁸	2007	"Both types of radiation were found to decrease significantly and non thermally the insect's reproductive capacity, but GSM 900 MHz seems to be even more bioactive than DCS 1800 MHz. The difference seems to be dependent mostly on field intensity and less on carrier frequency."
Erogul O et al. ⁶⁹	2006	"These data suggest that EMR emitted by cellular phone influences human sperm motility. In addition to these acute adverse effects of EMR on sperm motility, long-term EMR exposure may lead to behavioral or structural changes of the male germ cell. These effects may be observed later in life, and they are to be investigated more seriously."
Aitken et al. ⁷⁰	2005	"...while RF-EMR does not have a dramatic impact on male germ cell development, a significant genotoxic effect on epididymal spermatozoa is evident and deserves further investigation."
Fejes I et al. ⁷¹	2005	"Low and high transmitter groups also differed in the proportion of rapid progressive motile sperm (48.7% vs. 40.6%). The prolonged use of cell phones may have negative effects on the sperm motility characteristics."

Table 6. Epidemiological Studies on Children and Potential Health Effects from Mobile Phone Use				
Study	Date	Health Effect	Finding	Location
Hardell et al.	2008	Brain tumors	Those who used cell phones before age 20 had >5-fold increase in glioma risk.	Sweden
CEFALO Study	2004–2008	Brain tumors	"Regular users of mobile phones were not statistically significantly more likely to have been diagnosed with brain tumors compared with nonusers."	Denmark, Norway, Sweden, and Switzerland
Danish National Birth Cohort/ UCLA	1998–2008	Behavioral	Behavior problems	Denmark
Rezk et al., Egyptian hospitals	2003–2004	Heart rate	Increased fetal and neonatal heart rate	Egypt
MOCHE	2006–2010	Environmental exposures during pregnancy and childhood	Pending	Korea
MOBI-KIDS Study	Began 2010	Brain tumors	Pending	Australia, Austria, Canada, France, Germany, Greece, Israel, Italy, New Zealand, Spain, Taiwan, and the Netherlands
MoRPHeUS	2005–2010	Cognitive ability, blood pressure, or hearing	Shorter response times on learning tasks; less accurate working memory	Australia

As these summaries prove, proffers to the effect that “the consensus in the scientific community continues to be that the Commission’s standards protect human

health”⁵⁴ misrepresent the view of the scientific community with respect to the health impact of RF energy from cell phones. As the FCC itself acknowledges:

As long ago as the 1979 Inquiry we sought to gather information “in light of the increased concern about the biological effects of radio frequency radiation.” At that time, **just as is evident today, there were “considerable differences of opinion about the biological effects of low level (i.e., non-thermal or athermal) and long-term (chronic) exposure to RF radiation.”**⁵⁵

One commenter mischaracterizes the evidence of health impacts associated with RF energy, specifically with respect to non-thermal impacts, stating, “virtually all of U.S. and international health agencies and the scientific community generally, determined that the scientific literature does not support the existence of such “non-thermal effects.”⁵⁶ In support of this “present tense” proposition, the commenter cites language from an FCC proceeding concluded in 1997.⁵⁷ The commenter further states, “There is no scientific basis on which to regulate RF emissions beyond the heat-based limits that were and still are supported by the consensus of the international scientific community.”⁵⁸ But various recent studies have disproven the notion that cell phone radiation only causes thermal effects—including, among others, the Volkow study.⁵⁹ Industry commenters also mischaracterize the GAO Report. For example GAO did not find, as TIA claims, “no additional margin for precaution is needed”⁶⁰ and GAO did not conclude, as CTIA

⁵⁴ CTIA Comments, at page 18.

⁵⁵ NOI Section 208, at pages 73-74, emphasis added.

⁵⁶ CTIA Comments, at page 12.

⁵⁷ *Id.*, at page 12, footnote 61, citing “RF Order II” – *In re Procedures for Reviewing Request for Relief from State and Local Regulations*, Order, 12 FCC Rcd 13494, 13496 (1997).

⁵⁸ CTIA Comments, at page 26.

⁵⁹ See Volkow N., footnote 50, *supra*.

⁶⁰ TIA Comments, at page 19.

claims, that the consensus view is that the FCC's standards "are overly protective."⁶¹ In fact, GAO stated the opposite: "By not formally reassessing its current limit, FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure."⁶²

Commenters also suggest that—since adverse health effects from RF energy have not yet been conclusively proven and the scientific community is not uniformly in agreement—there is no risk, and that health effects from RF energy will never exist.⁶³ This is despite the fact that cell phones are relatively new technology and widespread cell phone use has only been around for the past 10-15 years, the first iPhone was only released in 2007, adoption of cell phones by children is a very recent phenomenon, and brain cancer has a long latency period, and research data on long-term cell phone use is very limited (for 10-15 years) or does not exist (for >15 years). Even *known* carcinogens such as tobacco and outdoor air pollution took decades or more to manifest themselves in "proven" health impacts.⁶⁴

By (among other things) citing a 50X safety factor that is based on 20-year-old science and mischaracterizing the state of the science today, commenters hope that FCC

⁶¹ CTIA Comments, at page 2.

⁶² GAO Report, Highlights page.

⁶³ For example CTIA states, "*without any scientific evidence that the current rules pose any danger to human health, there is no need for additional regulation in the area of consumer 'disclosures' or encouraging consumers to limit their exposure to RF emissions.*" CTIA Comments, at page 15.

⁶⁴ Dr. Christopher Wild, Director of the IARC, has stated: "Often we're looking at two, three or four decades once an exposure is introduced before there is sufficient impact on the burden of cancer in the population to be able to study this type of question." *Quoted in* Kelland, K. and Nebehay, S., *Air Pollution is a Leading Cause of Cancer*, Scientific American, October 17, 2013, available online at <http://www.scientificamerican.com/article.cfm?id=air-pollution-a-leading-cause-of-ca>. Similarly, cigarettes had existed in the United States in crude form since the early 1600's and became widely popular after the Civil War. By 1944, the American Cancer Society began to warn about possible ill effects of smoking, although it admitted that "no definite evidence exists" linking smoking and lung cancer. In 1964, a report by the Surgeon General's Advisory Committee on Smoking and Health concluded: "Cigarette smoking is causally related to lung cancer in men." In 1965, Congress passed the Federal Cigarette Labeling and Advertising Act requiring the Surgeon General's warnings on all cigarette packages.

will do what industry itself has avoided doing—unqualifiedly designate devices as safe; make no further changes to the testing guidelines; provide no further information to consumers; and conclude that further time spent on this proceeding has little utility. The FCC should not take the bait. Unless and until the science can demonstrate that cell phones are safe to a reasonable scientific certainty, the FCC must expeditiously modify the device testing guidelines, in order to better protect and inform consumers.

E. Courts Have Not Ruled on the Merits of the FCC’s RF Exposure Standards

Commenters’ suggestions that federal courts have already ruled on the merits of these issues go too far. CTIA claims that “[t]wo different courts of appeal rejected petitions for review arguing that the adopted standards did not adequately protect the public.”⁶⁵ These courts, however, did not address the merits of the FCC’s RF exposure standards *per se* but, instead, dismissed the claims under the courts’ highly constrained standard of review. In *Cellular Phone Taskforce v. FCC*⁶⁶, for example, petitioners sought among other things to invalidate the very FCC guidelines under review in the NOI. The court articulated the standard of review for these claims, as follows:

The agency’s action should only be set aside where it relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the products of expertise.⁶⁷

Viewed in this light, the court held that the FCC’s actions were not “arbitrary or

⁶⁵ CTIA Comments, at page 13. See footnotes 63-65 therein.

⁶⁶ *Cellular Phone Taskforce v. FCC*, 205 F.3d 82 (2d Cir. 2000).

⁶⁷ *Id.*, citing *Motor Vehicle Mfrs. Ass’n v. State Farm Auto. Ins. Co.*, 463 U.S. 29, 43, 103 S. Ct. 2856, 77 L.Ed.2d 443 (1983) (internal quotation marks omitted).

capricious” within the terms of the Administrative Procedures Act.⁶⁸

Likewise, in *EMR Network v. FCC*⁶⁹, the court dismissed the petitioners’ challenge of the FCC’s decision not to regulate non-thermal RF radiation effects, inasmuch as the FCC’s actions were not “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.”⁷⁰ The court expounded:

Presumably later actions pursuant to the [regulatory] plan might be significant enough to require [National Environmental Policy Act] filings, just as some FCC actions relating to RF radiation will need new environmental studies — including, for example, the circumstances where the current regulations call for such studies. But the regulations having been adopted, there is at the moment no “ongoing” federal action, . . . and no duty to supplement the agency’s prior environmental inquiries.⁷¹

The current proceedings are, of course, “ongoing” and altogether different in scope, and aspire to achieve more than what is simply not “implausible, arbitrary, or capricious.”

Pong, in sum, does not assert that cell phones are “unsafe” (as that notion, too, remains unestablished), but holds the scientifically-grounded view that *less exposure* to cell phone radiation—at any level that is possibly harmful—is “*safer*” than more, pending reasonably conclusive proof that human exposure to RF radiation under actual operating positions and conditions is not harmful in any respect. The FCC should advise consumers to exercise caution in this regard, instead of (albeit in the “code” language of the SAR standard) stating—for the industry, as it will not do itself—that cell phones are “safe.”

⁶⁸ Administrative Procedure Act (“APA”), 5 U.S.C. §500 *et seq.*

⁶⁹ *EMR Network v. FCC*, 391 F.3d 269 (D.C. Cir. 2004).

⁷⁰ *Id.*, citing the APA, 5 U.S.C. §706(2)(A).

⁷¹ *Id.*, citations omitted.

II. THE FCC SHOULD DISMISS ASSERTIONS THAT CURRENT FCC GUIDELINES ACCURATELY MEASURE CHILDREN’S EXPOSURE TO RF ENERGY. THE FCC’S TESTING GUIDELINES SHOULD BE MODIFIED TO BETTER PROTECT CHILDREN.

Pong previously has cited evidence in this docket that children in fact absorb substantially greater levels of RF energy than adults.⁷² Pong also noted in its comments that the SAM model used for testing of wireless devices does not adequately model for use of devices by children.⁷³ Other commenters also cited studies and provided extensive evidence, demonstrating that children absorb far more RF energy than do adults, and that the SAM model underestimates true radiation absorption by children.⁷⁴ A substantial body of evidence has been entered in the record in this proceeding, militating for changes to the FCC’s testing regime, as they relate to children.

Commenters who oppose modifications to the current standard generally rely on statements, for example from IEEE dating to 1991,⁷⁵ as well as on FDA statements on its web site that “[t]he scientific evidence does not show a danger to any users of cell phones

⁷² Pong Comments, at pages 6-10.

⁷³ *Id.*, at pages 8-10.

⁷⁴ See EWG Comments, at pages 3-9, and AAP Comments. AAP notes, “Current FCC standards do not account for the unique vulnerability and use patterns specific to pregnant women and children. It is essential that any new standard for cell phones or other wireless devices be based on protecting the youngest and most vulnerable populations to ensure they are safeguarded throughout their lifetimes.” And again, “Many children, adolescents and young adults, now use cell phones as their only phone line and they begin using wireless phones at much younger ages. Pregnant women may carry their phones for many hours per day in a pocket that keeps the phone close to their uterus. Children born today will experience a longer period of exposure to radio-frequency fields from cellular phone use than will adults, because they start using cellular phones at earlier ages and will have longer lifetime exposures. FCC regulations should reflect how people are using their phones today.” *Id.* See also Filing of Dr. Om P. Gandhi dated August 24, 2013 in Docket 13-84, at <http://apps.fcc.gov/ecfs/document/view?id=7520945322>.

⁷⁵ For example, TIA notes: “The current FCC, IEEE, and ICNIRP standards all have been determined by the expert groups that developed them and by independent expert panels to provide a substantial margin of safety—up to fifty-fold—for users of consumer RF devices. See, e.g., IEEE Standards Coordinating Committee 28 on Non-Ionizing Radiation Hazards, ‘IEEE Standard for Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 400 GHz,’ at 28 (Sept. 26, 1991).” TIA Comments, at page 7.

from RF exposures, including children and teenagers.”⁷⁶

But among other things, these general and dated pronouncements directly contradict the very purpose of this proceeding, which is to update the record given that: (a) much time has passed since the FCC’s standards were developed in 1997; (b) much research has been concluded since 1997, including research that shows possible risks; and (c) much research remains to be done. Further, these pronouncements contradict other statements, from FDA itself and other organizations, including the GAO.⁷⁷

But whatever FDA’s web site might state, the facts are that extensive scientific evidence demonstrates that children absorb substantially more RF energy than adults, and that the SAM model does not adequately account for children. Further, while some scientific studies have shown potential health risks, and other studies have not demonstrated risk, thus far the science has not been able conclusively to determine that cell phones are, in fact, safe.

One commenter notes, “For years, SAM has been the preferred method and the industry standard for compliance,” that it is the “only specifically approved method for demonstrating compliance with RF standards” and “time-tested.”⁷⁸ But these general statements do not address the extensive evidence submitted in the record, that SAM (and the testing regime as a whole) should be modified better to account for use of devices by children. In the NOI, the FCC “ask[s] that commenters provide specific data and information,” and emphasizes that “[v]ague or unsupported assertions regarding costs or

⁷⁶ *Id.*, at page 25.

⁷⁷ See footnote 51, *supra*.

⁷⁸ CTIA Comments, at page 53.

benefits generally will receive less weight and be less persuasive than the more specific and supported statements.”⁷⁹ The FCC must give weight to the extensive evidence already presented in this proceeding regarding the need to better account for use of wireless devices by children in the FCC’s testing regime.

As we previously noted, use of wireless devices by children has skyrocketed since the FCC first developed its testing guidelines in 1997. Teens generally keep their devices on their persons (in so-called “body-worn configurations”) for extensive exposure periods, indeed for hours per day, and even sleep with their phones on their beds or under their pillows.⁸⁰ Common Sense Media, in fact, has recently reported that, among children under 2 years of age, 38% had used mobile devices—the same share as children 8 and under who had used such technology just two years ago.⁸¹ According to this report:

The amount of time spent using these devices has tripled [in two years], from an average of [five minutes] a day among all children in 2011 up to [fifteen minutes] a day in 2013. . . . The difference in the average time spent with mobile devices is due to two factors: expanded access, and the fact that those who use them do so for longer periods of time. Among those who use a mobile device in a typical day, the average went from [43 minutes] in 2011 to [1 hour and 7 minutes] in 2013.⁸²

For context, the Interphone study showed a 40% increased risk of glioma in adults described as “heavy users” of cell phones—a metric that then equated to just 27 minutes

⁷⁹ NOI, Section 209, at page 74.

⁸⁰ <http://children.webmd.com/features/children-and-cell-phones>. Pew reports 84% of teens sleep with their cell phones on or close to their beds. See http://www.pewinternet.org/~media/Files/Reports/2010/PIP_Adults_Cellphones_Report_2010.pdf, at page 22.

⁸¹ Common Sense Media, *Zero to Eight—Children’s Media Use in America 2013*, Fall 2013, available at <http://www.common sense media.org/sites/default/files/research/zero-to-eight-2013.pdf>.

⁸² *Id.*, at page 9.

of use per day.⁸³ Children, one must recall, absorb *between 1.5 to 10 times more* RF radiation than adults under similar exposures.⁸⁴

In our September 3, 2013 filing in this docket, we recommended that, with respect to children, the FCC should develop a more appropriate testing methodology that would—among other things—more accurately measure children’s “real SAR”; and we provided examples of how the FCC could accomplish this end.⁸⁵ The extensive evidence presented in the record of this proceeding supports such modifications by the FCC.

III. THE FCC SHOULD DISMISS SUGGESTIONS THAT PROXIMITY REQUIREMENTS WITH RESPECT TO THE FCC’S CURRENT TESTING REGIME ACCURATELY MEASURE TRUE RADIATION ABSORPTION BY USERS. THE RECORD DEMONSTRATES THAT THE FCC SHOULD MODIFY ITS TESTING GUIDELINES TO ACCOUNT FOR ZERO SPACING, WHICH IS HOW CONSUMERS NORMALLY USE DEVICES.

The record in this proceeding demonstrates that the FCC’s current testing guidelines, which permit testing at up to 25 cm distance in body-worn configuration, do not accurately measure true radiation absorption by users, including children, and that the proximity requirements for testing should be modified to include a zero spacing requirement. In our September 3, 2013 filing, we provided extensive testing data demonstrating how SAR substantially exceeds the FCC’s safety limits when devices are held adjacent to the body in body-worn configuration, which is how most consumers carry devices.⁸⁶

The GAO Report called for the FCC to update its portable device radiation

⁸³ See Section I.D, *supra*.

⁸⁴ See Section I.C, *supra*.

⁸⁵ Pong Comments, at page 10.

⁸⁶ *Id.*, at pages 11-16.

exposure and testing guidelines. According to the GAO Report, current FCC standards—in place since 1997 (some 4 years before the first smartphones became commercially available)—“*may not reflect the latest research,*”⁸⁷ “*may not identify maximum exposure [to radiation] in all possible usage conditions,*”⁸⁸ and do not test for use of phones against the body, which “*could result in RF energy exposure higher than the FCC limit.*”⁸⁹ GAO noted that current testing guidelines exclude testing against the body and may, therefore, underestimate true radiation absorption. GAO stated:

By not formally reassessing its current limit, FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure. FCC has also not reassessed its testing requirements to ensure that they identify the maximum RF energy exposure a user could experience. **Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit.**⁹⁰

In spite of the evidence, one commenter states that it “does not believe a zero-spacing measurement requirement would accurately mimic real usage or increase safety.”⁹¹ As we noted in our September 3, 2013 filing, even a leading device manufacturer conceded that the FCC’s SAR limit is likely exceeded when consumers carry devices in normal fashion—i.e., in their pockets; which is how most consumers carry devices. An Apple iPhone manual states:

⁸⁷ GAO Report, *Highlights* page, emphasis added.

⁸⁸ *Id.*, emphasis added.

⁸⁹ *Id.*, emphasis added. The GAO Report states: “Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in [radio frequency (“RF”) energy exposure higher than the FCC limit.” Further, the GAO Report observes: “Some consumer groups noted that they would like FCC to mention the IARC’s recent classification of RF energy exposure as ‘possibly carcinogenic’ on FCC’s website.” *Id.*, at page 26.

⁹⁰ *Id.*, *Highlights* section, emphasis added.

⁹¹ CTIA Comments, at page 17.

iPhone’s SAR measurement may exceed the FCC exposure guidelines for body-worn operation if positioned less than 15 mm (5/8 inch) from the body (e.g., **when carrying iPhone in your pocket**).⁹²

In spite of the extensive evidence in the record, one commenter opposed to changes to proximity in testing, noted the following:

Furthermore, operation of devices much closer to, or in actual contact with, the body may degrade performance. Therefore, testing devices that are operating too close to the body may result in antenna performance being negatively affected. Testing should be performed in configurations that allow the device to operate properly. The fact that consumers may occasionally use their devices in suboptimal physical configurations—of which there an infinite variety—should not require testing that would mimic every conceivable configuration.”⁹³

This comment essentially proves the point that testing should be conducted at zero spacing. First, as the commenter notes, it is true that “operation of devices much closer to, or in actual contact with, the body may degrade performance.” It is also true, as the commenter notes, that “testing devices that are operating too close to the body may result in antenna performance being negatively affected.” But these observations beg the question: why does operation of a device closer to or in actual contact with the body degrade performance? And why does testing of devices “too close to the body” result in antenna performance being negatively affected? The answer, is that, at closer proximities to the body—which is how most consumers use devices—*between 48% and 68% of the*

⁹² See http://manuals.info.apple.com/en_US/iPhone_3G_Important_Product_Information_Guide.pdf, at page 7, emphasis added. This warning appeared in the online version of the guide for the 3GS model (downloaded on June 3, 2013), but did not appear in the online versions of the Guides for the iPhone 4, 4S, 5, or 5S models.

⁹³ CEA Comments, at page 13.

*RF energy from the device is absorbed into the head, brain or body.*⁹⁴ As such, of course the performance of the device will be adversely affected, since RF energy does not propagate into the far field to communicate with a cell tower, but rather is absorbed into the head or body of the user.

The next sentence by the commenter—i.e., that “testing should be performed in configurations that allow the device to operate properly”—completely mischaracterizes what the FCC designed its testing guidelines to achieve. The FCC intended to replicate *normal operating positions or conditions*—as consumers ordinarily use such devices—and not how a manufacturer or industry group would like those devices to be used in a fictitious setting, or to achieve artificial, unrealistic test results. Similarly the statement that consumers “occasionally use their devices in suboptimal physical configurations—of which there an infinite variety”—is obfuscatory and mischaracterizes how consumers normally use devices—which again, very simply, is directly against their bodies in body-worn configuration for many hours throughout the day.

Another commenter similarly posits: “A phone’s antennas perform best when the antennas are not directly adjacent to a body, due to dielectric loading from the body.”⁹⁵ Again, “dielectric loading from the body” is simply abstruse, scientific terminology that describes what (unbeknownst to most consumers) is actually occurring when they use their device in normal fashion (i.e., very close to or touching the body): RF energy from the device is absorbed into the head or body, rather than propagating into free space and

⁹⁴ See, e.g., Nielsen, J.O. and Pedersen, G.F., “Mobile Handset Performance Evaluation Using Radiation Pattern Measurements,” IEEE Transactions on Antennas and Propagation, Vol. 54, No. 7, July 2006, <http://vbn.aau.dk/files/7274376/01650415.pdf>.

⁹⁵ TIA Comments, at page 25.

communicating with the cell tower. The commenter similarly concedes that, because of this dynamic, when a consumer uses the device in its intended manner close or adjacent to the body, “*performance is compromised as a phone approaches zero separation.*”⁹⁶

The commenter concludes,

Thus, testing procedures that are revised and reoriented toward decreased spacing will compel redesigned products that either: (1) *have shorter ranges* for optimum performance, or (2) have features that limit performance capabilities by *limiting power and/or transmissions* when the product is being carried on the body.”⁹⁷

It is important to note in light of TIA’s comments that, first, 8 days after TIA’s filing, Apple released its flagship iPhone 5S smartphone, which does exactly what TIA cautioned against in this proceeding: it includes “features that limit performance capabilities by limiting power and/or transmissions when the product is being carried on the body.” The following table from Apple’s SAR Evaluation Report for the iPhone 5S⁹⁸ describes this architecture:

⁹⁶ *Id.*, emphasis added.

⁹⁷ *Id.*, emphasis added.

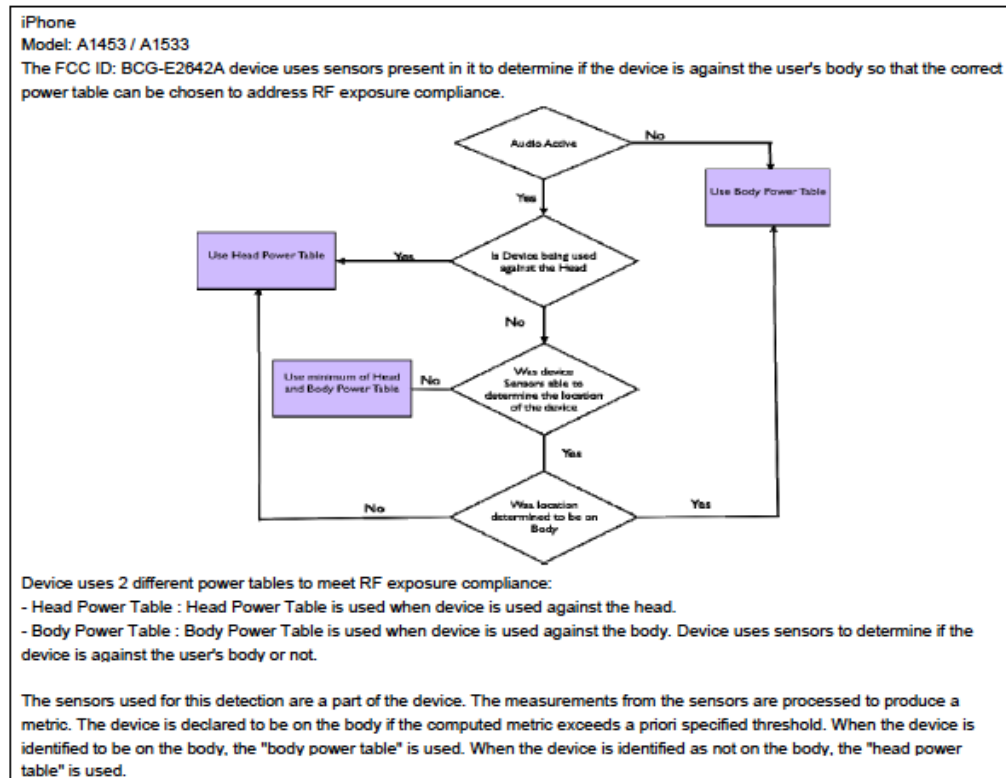
⁹⁸ SAR Evaluation Report for iPhone Model A1453/A1533, FCC ID: BCG-E2642A, Report #13U14987-22C, prepared for Apple Inc. by UL Verification Services, Inc., September 5, 2013, at page 16.

Report No.: 13U14987-22C
FCC ID: BCG-E2642A

Issue Date: 9/5/2013

7. Device Under Test

7.1. General Information



As this report notes:

[The iPhone 5S] uses sensors present in it to determine if the device is against the user's body so the correct power table can be chosen to address RF exposure compliance.⁹⁹

While not entirely clear from the Report, the proximity sensors in the iPhone 5S appear to enable the antenna to detect impedance changes from its surroundings, i.e., when next to a body.

Pong has determined, however, that the "sensing" antenna is also influenced by

⁹⁹ *Id.*

other proximate solids, including cases—even Apple’s own “precisely designed” and “precision crafted”¹⁰⁰ case for the iPhone 5S. Impedance changes to the antenna resulting from the presence of a case, in turn, affects antenna performance by reducing transmitted signal or “Total Radiated Power” (“TRP”)¹⁰¹ on some channels and increasing SAR on others. These results vary unpredictably from case to case, *except for Pong’s case that increases outbound signal compared to other cases and decreases SAR*. Put another way, the OEM case from Apple—as well as other after-market cases—can negatively impact cellular performance for the iPhone 5S and can *increase*, rather than “address,” consumers’ exposure to RF radiation.¹⁰² But although these cases are sold by Apple as the OEM of the corresponding device—and, so, “supplied or designated for this product” within the terms of current FCC regulations¹⁰³—they need **not** (unlike belt clips and holsters) be tested “*with the [accessory] attached to the device and positioned against a flat [SAR-testing] phantom in normal use configurations.*”¹⁰⁴ Because the “radiation profile” of a given device with a case may bear little resemblance to that of the same device without a case, the failure to account for cases may eviscerate the entire equipment authorization process.

¹⁰⁰ <http://store.apple.com/us/product/MF045LL/A/iphone-5s-case-black?fnode=47>.

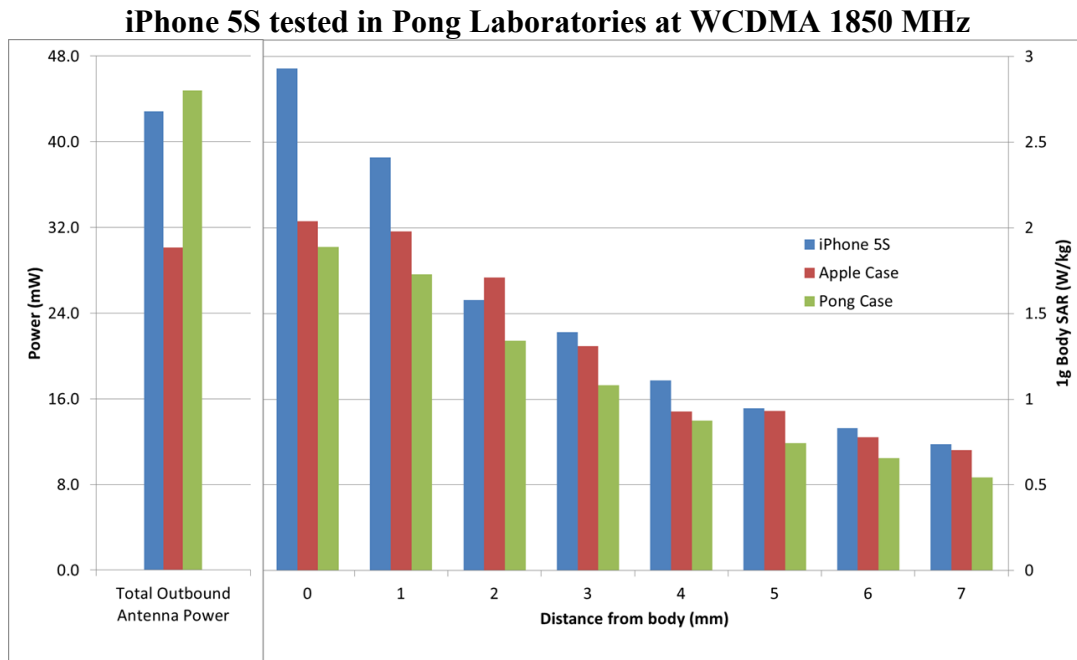
¹⁰¹ TRP measures signal strength of the portable device itself, while Total Isotropic Sensitivity or “TIS”—typically shown by “bars” on a device’s graphic user interface—measures inbound signal from a cell tower to the device.

¹⁰² The FCC has expressly acknowledged that the presence of accessories will “affect the SAR produced by the transmitting device,” and that “the physical spacing to the body of the user as dictated by the accessory and the materials used in an accessory affect the SAR produced by the transmitting device.” Supplement C, at page 41.

¹⁰³ *See id.* With great foresight, the FCC anticipated that consumers might procure accessories like belt clips and holsters not only from OEMs but also in the aftermarket. Although no meaningful aftermarket for accessories such as cases existed in 2001, the FCC indicated that OEMs like Apple should caution consumers that “[u]se of other [non-OEM] accessories may not ensure compliance with FCC RF exposure guidelines.” *Id.*, at page 41.

¹⁰⁴ *Id.*

The chart below illustrates these points.¹⁰⁵

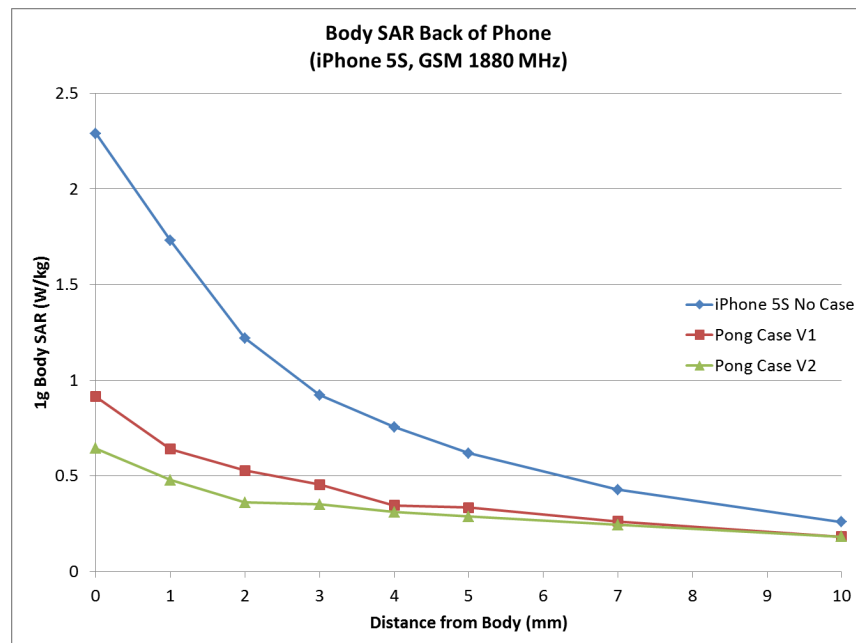


When the Apple case is attached to the iPhone 5S, TRP decreases because of the proximity sensor architecture and antenna sensitivity and, as one would expect, so does SAR. But with a Pong case, outbound signal is *not* reduced although SAR decreases substantially below the levels shown in both the “bare” iPhone 5S and Apple case scenarios. It is important in this context to remember that radiated power is a function of the source antenna only, *not* distance from the antenna. As the signal travels further from

¹⁰⁵ Pong tested the iPhone 5S in this example at WCDMA 1850 MHz. The increased SAR profile in actual use might even exceed the “theoretical” assumptions that inform the Commission’s safety standard of 1.6 W/kg. This result could obtain because the efficiency of an antenna depends on the impedance of its surrounding medium. Cellular antennas are typically designed to operate surrounded mostly by air. Changing the material surrounding the antenna—for example, with a case—can alter the impedance match and affect the antenna’s efficiency. In some scenarios (dependent on frequency and dielectric properties) efficiency can be improved, so that the antenna radiates more power. The addition of a case to a device, however, could change antenna efficiency and increase radiated power, so that the safety limit is violated. In any event, the stated SAR rating of a device for purposes of its equipment authorization would differ from its actual SAR emission with the addition of a form-fitting case. The fact that consumers generally use their devices against their heads and bodies—again, contrary to the assumptions that underlie both the Commission’s safety standard and equipment authorization testing regulations—would exacerbate this state of affairs.

the source it spreads in out in space, so that the intensity at any fixed point in space is reduced, but the sum of the field in all space (or *total* power) remains constant.

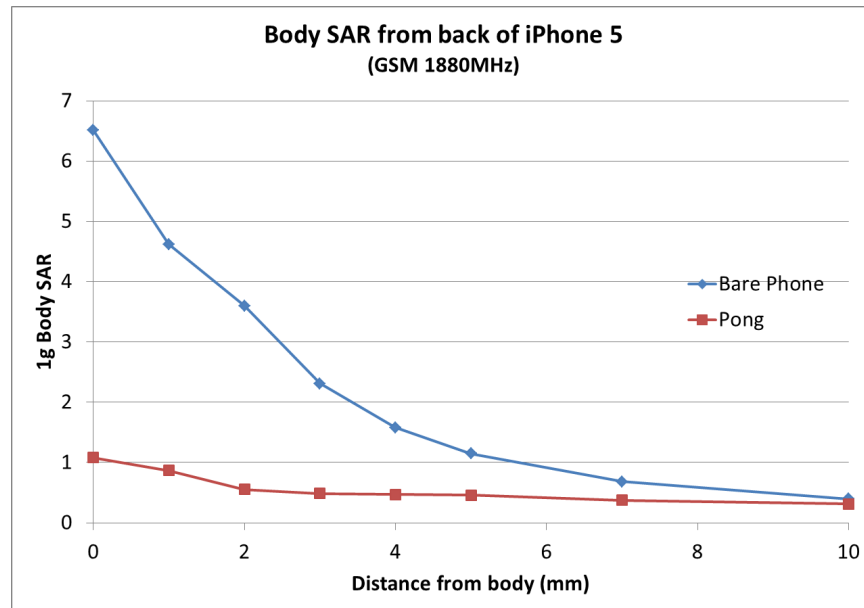
While a Pong case benefits outbound signal, it dramatically reduces SAR—especially at the “normal operating position” of “zero distance.” The graph below illustrates the impact on body SAR of two versions of the Pong case versus a bare iPhone 5S, measured at up to “zero distance” from the back of the smartphone. With a Pong case, SAR remains substantially below the current standard of 1.6 W/kg, while the iPhone 5S itself exceeds the limit at 1 mm.



The iPhone 5S achieves even these results, however, at the expense of TRP—due to its proximity sensor architecture and antenna sensitivity, as described above. Results are more dramatic for the iPhone 5 that lacks these elements.

The iPhone 5 under the same conditions exceeds FCC safety limits at up to 4 mm and, at “zero distance,” **demonstrates SAR of 6.5 or more than 4 times the current**

safety limit. With a Pong case, however, iPhone 5 SAR remains nearly 40% *below* the limit, even at “zero distance”—and *6.5 times less* than that of a bare iPhone 5.



Apple uses a proximity sensor architecture similar to that of the iPhone 5S for its leading tablet product, the iPad.¹⁰⁶ In its SAR Evaluation Report for the iPad 2¹⁰⁷, for example, Apple disclosed the following:

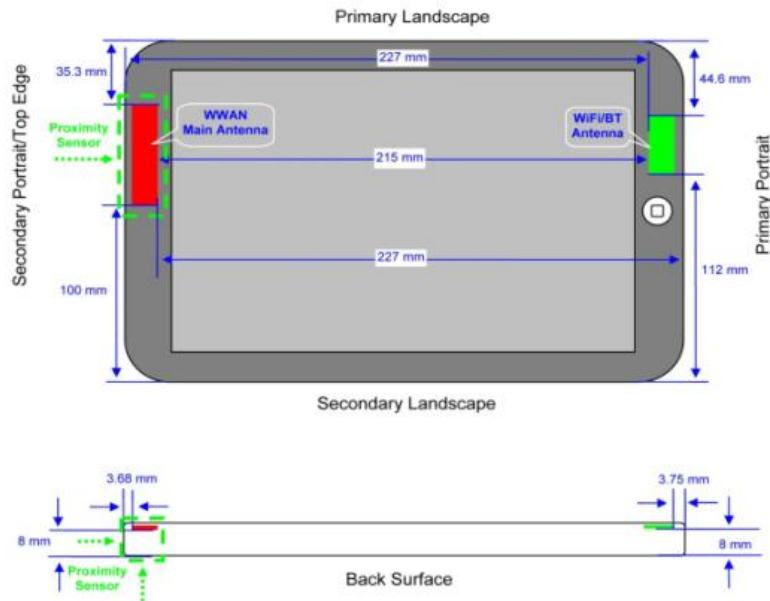
¹⁰⁶ WIRED magazine independently investigated the proximity sensor architecture’s impact on iPad performance, both with and without a Pong case. See Phillips, J., *Can a \$100 iPad Case Improve 3G Data Power? Lab Test!*, WIRED.com, December 15, 2011, <http://www.wired.com/gadgetlab/2011/12/pong-ipad-case-investigation>.

¹⁰⁷ SAR Evaluation Report for iPad Model A1396, FCC ID: BCGA-1396, Report #10U13582-1B, prepared for Apple Inc. by Compliance Certification Services, Inc., March 1, 2011, at page 45.

REPORT NO: 10U13582-1B
FCC ID: BCGA1396

DATE: March 1, 2011
IC: 579C-A1396

16. ANTENNAS LOCATIONS AND SEPARATION DISTANCES



A subsequent report¹⁰⁸ for a later iPad version similarly noted:

REPORT NO: 11U14054-4B
FCC ID: BCGA1430

DATE: February 13, 2012
IC: 579C-A1430

6. Proximity Sensor Operation

A Proximity sensor for power reduction is implemented in this device to address RF exposure compliance when the cellular antenna is positioned close to the user's body. The sensor mechanical structure is designed to fit within the enclosure design used in this device and also extended around the edge and top of the antenna element in order to optimize sensitivity in these orientations. This design combines the antenna and proximity sensor into a single FPC (Flexible Printed Circuit).

6.1. Description

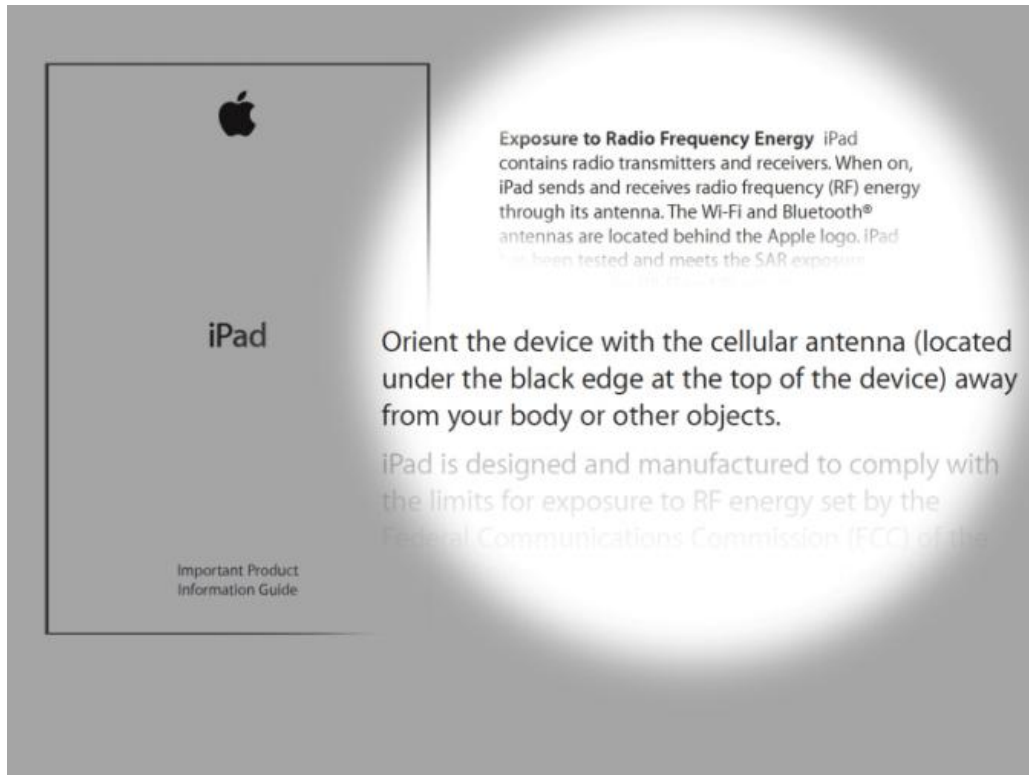
The device, model A1430, utilizes a capacitive proximity sensor built into the plastic area that houses the cellular radio antenna. This area can be found on the top edge and the front/Rears of the device, when the device is oriented in the portrait orientation and the I/O port is at the bottom. The purpose of the proximity sensor is to cap the transmitter output power when the device's cellular antenna is proximate to the human body.

For design and testing purposes Top-Edge, Front Surface, and Rear are chosen as the dimensions of interest. The minimum detection distances for these dimensions are: 14 mm (Top-Edge), 14mm (Front), and 11 mm (Rear)

Commensurate with other caution statements to the effect that consumers should not

¹⁰⁸ SAR Evaluation Report for iPad Model A1430, FCC ID: BCGA-1430, Report #12U14315-2, prepared for Apple Inc. by Compliance Certification Services, Inc., March 12, 2012, at page 16.

place cellular antennas proximate to their bodies¹⁰⁹, Apple advised:



Like Apple's case for the iPhone 5S, Apple also produces a "Smart Cover" for the iPad. On Apple's web site, it states, "*The Smart Cover and iPad work so well together, it's easy to think of them as one device.*"¹¹⁰ The web site notes, "*We designed iPad to work with the Smart Cover — and the other way around.*"¹¹¹ Various characteristics are promoted on the web site, including looks, colors, and comfortable typing position. In addition to these functional and aesthetic characteristics however, the Smart Cover also happens to trigger the iPad's proximity sensor, causing material reductions in TRP in scenarios wherein the iPad is actually *not* proximate to a human body but merely enclosed in a case. Similar results occur with every other after-market iPad case, *except*

¹⁰⁹ See, e.g., footnote 92, *supra* (citing warnings in the iPhone manual).

¹¹⁰ See <http://www.apple.com/ipad/smart-cover/>.

¹¹¹ *Id.*

for the Pong case. Apple itself discloses¹¹² that, a result of the proximity sensor, iPad TRP can drop as much as 10 dB—a 90% power loss:

REPORT NO: 11U14054-4B
FCC ID: BCGA1430

DATE: February 13, 2012
IC: 579C-A1430

Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Tx Conducted Pwr (dBm)	
					W/o Pwr back-off	W/ Pwr back-off
UMTS (WCDMA) Band V	Subtest 1	4357	826.4	0	24.7	19.2
		4408	836.6	0	24.6	19.1
		4458	846.6	0	24.4	18.9
	Subtest 2	4357	826.4	2	22.8	17.3
		4408	836.6	2	22.6	17.1
		4458	846.6	2	22.8	17.3
	Subtest 3	4357	826.4	1	23.5	18.0
		4408	836.6	1	23.5	18.0
		4458	846.6	1	23.4	17.9
	Subtest 4	4357	826.4	2	23.2	17.7
		4408	836.6	2	23.1	17.6
		4458	846.6	2	23.2	17.7
	Subtest 5	4357	826.4	0	24.5	19.0
		4408	836.6	0	24.5	19.0
		4458	846.6	0	24.6	19.1
UMTS (WCDMA) Band II	Subtest 1	9262	1852.4	0	22.8	14.8
		9400	1880.0	0	22.7	14.7
		9538	1907.6	0	22.7	14.7
	Subtest 2	9262	1852.4	2	20.8	12.8
		9400	1880.0	2	20.7	12.7
		9538	1907.6	2	20.9	12.9
	Subtest 3	9262	1852.4	1	21.8	13.8
		9400	1880.0	1	21.8	13.8
		9538	1907.6	1	21.8	13.8
	Subtest 4	9262	1852.4	2	20.9	12.9
		9400	1880.0	2	20.8	12.8
		9538	1907.6	2	20.8	12.8
	Subtest 5	9262	1852.4	0	22.8	12.8
		9400	1880.0	0	22.8	12.8
		9538	1907.6	0	22.8	12.8

These results correspond to the following performance characteristics of the iPad with a Smart Cover or other case¹¹³ versus a Pong case:

¹¹² SAR Evaluation Report for iPad Model A1430, FCC ID: BCGA-1430, Report #11U14054-4B, prepared for Apple Inc. by Compliance Certification Services, Inc., February 13, 2012.

¹¹³ The Smart Cover does is not designed for the iPad 1, but only for later versions.

Device	Proximity Sensor Power Reduction (dB)	Proximity Sensor Power Reduction (%)	Proximity Sensor Range Reduction (%)	Pong Improvement in Signal Strength	Pong Improvement in Range
iPad 1	8.5	85.9	62.4	7.1X	2.7X
iPad 2 (Verizon)	7	80.0	55.3	5.0X	2.2X
iPad 2 (AT&T)	6.2	76.0	51.0	4.2X	2.0X
New iPad (Verizon 3G)	7.5	82.2	57.8	5.6X	2.4X
New iPad (Verizon LTE/4G)	5.5	71.8	46.9	3.5X	1.9X
New iPad (AT&T 3G)	10	90.0	68.4	10.0X	3.2X
New iPad (AT&T LTE/4G)	8.2	84.9	61.1	6.6X	2.6X

At the same time, CETECOM Inc.—a “Telecommunications Certification Body”¹¹⁴—

showed in its labs that the Pong case materially reduce SAR.

iPad 2			1g SAR (W/kg)		%	% Below
Network	Band	Frequency (MHz)	Without Pong	With Pong	Reduction	FCC Limit
	CDMA 850	836.5	1.3	0.515	60.4	67.8
Verizon	CDMA 1900	1850	0.809	0.279	65.5	82.6
	CDMA 1900	1880	0.783	0.293	62.6	81.7
	WCDMA 850	826.4	1.05	0.34	67.6	78.8

¹¹⁴ See www.cetecom.com. Pong tests its cases in third-party facilities (including CETECOM) certified by the FCC, and calibrates its own extensive equipment to these industry standards.

AT&T	WCDMA 850	836.6	1.33	0.454	65.9	71.6
	WCDMA 1900	1880	1.44	0.445	69.1	72.2
			10g SAR (W/kg)		%	% Below
	Band	Frequency (MHz)	Without Pong	With Pong	Reduction	ICNIRP Limit
International	WCDMA 850	826.4	0.556	0.202	63.7	89.9
	WCDMA 850	836.6	0.705	0.269	61.8	86.6
	WCDMA 2100	1950	0.641	0.229	64.3	88.6

Thus—contrary to one commenter’s concern that “testing procedures that are revised and reoriented toward decreased spacing will compel redesigned products that either: (1) *have shorter ranges* for optimum performance, or (2) have features that limit performance capabilities by *limiting power and/or transmissions* when the product is being carried on the body.”¹¹⁵—***technologies currently exist*** in the marketplace that obviate the need for wireless device proximity sensors that degrade performance of the device, as such devices should *not* “have shorter ranges for optimum performance.” For example, Pong’s cases *reduce* SAR while *increasing* TRP.

These results notwithstanding, another commenter cites as justification for not modifying the testing requirements to include zero spacing in body-worn configuration, an FCC statement in Section 251 of the NOI, that “we have no evidence that this poses any significant health risk.”¹¹⁶ But this statement from the FCC contravenes the facts.

¹¹⁵ TIA Comments, at page 25, emphasis added.

¹¹⁶ CEA Comments, at page 11, *quoting* NOI, Section 251.

There is extensive evidence of potential health risks already entered into the record in this proceeding. Further, and again, GAO reiterates that “insufficient information was available to conclude mobile phones posed no risk,” and that “FDA stated that while the overall body of research has not demonstrated adverse health effects, some individual studies suggest possible effects. Officials from NIH, experts we interviewed, and a working group commissioned by IARC—the World Health Organization’s agency that promotes international collaboration in cancer research—have reached similar conclusions. For example, in May 2011 IARC classified RF energy as “possibly carcinogenic to humans.”¹¹⁷ Moreover, FCC itself has acknowledged its lack of scientific and medical expertise to assess the health impacts of wireless devices, noting, “Since the Commission is not a health and safety agency, we defer to other organizations and agencies with respect to interpreting the biological research necessary to determine what levels are safe.”¹¹⁸

As discussed in Pong’s September 3, 2013 filing, most consumers today rely heavily on their portable devices, and use and carry them against their heads and bodies for increasingly longer periods—such that “body-worn configuration” has become not the exception but the norm, and that testing a device 15 mm or more away from the person (for body-worn configuration) misrepresents “real SAR.” The record irrefutably demonstrates that consumers are exposed, for long periods of time each day, to SAR levels in excess of the FCC safety limit. The FCC, therefore, must modify its testing guidelines to account for zero spacing, which is how consumers ordinarily use devices in body-worn configuration.

¹¹⁷ GAO Report, at pages 6-7.

¹¹⁸ NOI Section 6.

An additional recent development has sharpened this point. OEMs, including Apple and Samsung, have developed prototype “curved screens” for mobile devices that will contour more closely than flat screens to the user.¹¹⁹ In developing curved devices, OEMs effectively have acknowledged that consumers want and use devices directly against the body, which bolsters the argument that testing should be conducted at zero spacing. It should be noted, too, that—because body SAR testing is done on a flat phantom, the architecture of a curved device might raise the antenna even further from the testing surface and, thus, artificially underestimate “real SAR” even more. The FCC should account in its testing procedures for these trends and should, at a minimum, require caution statements that SAR measurements for a curved device taken on a flat phantom might not reflect SAR accurately.

We respectfully submit that, in order properly to protect consumers, the FCC should update its testing guidelines to reflect the use of devices directly against the body rather than at between 15 mm and 25 mm away.¹²⁰ Most consumers hold their devices against their bodies. A space of at least 15 mm or more dramatically reduces SAR, but that is not how consumers typically—or, in the FCC’s words, as a matter of “normal operating positions or conditions”¹²¹—use devices. Modern habits tend towards much closer proximities, as well as longer exposures.

¹¹⁹ See, e.g., <http://www.theverge.com/2013/10/8/4818572/samsung-galaxy-round-curved-oled-smartphone-official> (describing the Samsung Galaxy “Round” smartphone).

¹²⁰ Cf. Filing of Pong Research Corporation dated June 29, 2012 in WT Docket 11-186 and ET Docket 03-137, <http://apps.fcc.gov/ecfs/document/view?id=7021981415> (addressing distance standards).

¹²¹ Bulletin 65, at page 42.

IV. BASED ON SUBSTANTIAL EVIDENCE IN THE RECORD, THE FCC SHOULD CONCLUDE THAT DEVICE CERTIFICATION TESTING SHOULD ACCOUNT FOR ACCESSORIES THAT ARE COMMON TODAY, AND THAT SUBSTANTIALLY IMPACT RF ENERGY ABSORPTION—SPECIFICALLY CASES.

Extensive evidence has been submitted in the record in this proceeding,¹²² demonstrating that: (a) cases can dramatically impact the radiation properties of wireless devices,¹²³ indeed, even cases with non-metallic parts;¹²⁴ (b) in contrast to 1997 when the FCC established its device testing guidelines, and accounted for belt clips and holsters in the device testing guidelines¹²⁵ (including caution statements with respect to such accessories),¹²⁶ today most consumers use cases;¹²⁷ (c) most consumers are unaware that cases can dramatically impact the radiation properties of their wireless device;¹²⁸ and (d) by changing the radiation profile of the device, cases essentially eviscerate the purpose of the FCC's device testing guideline, which is to simulate RF energy absorption by users of wireless devices during normal operating positions or conditions. Accordingly the FCC should conclude that the device testing guidelines must accommodate the presence of

¹²² Pong Comments, at pages 16-32.

¹²³ *Id.*

¹²⁴ *Id.*, at pages 27-32.

¹²⁵ Supplement C at page 41 states: "Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. Devices with a headset output should be tested with a headset connected to the device."

¹²⁶ Bulletin 65 also stipulated cautionary statements in user manuals, specifically to the effect that *certain accessories may cause the portable device to exceed the Commission's RF compliance requirements*. Bulletin 65 provided that "[I]n order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and caution statements should be included in the manual. The information should allow users to make informed decisions on the type of body-worn accessories and operating configurations that are appropriate for the device." Bulletin 65 further provided specific examples of such statements, including a warning that use of certain accessories "*may not ensure compliance with FCC RF exposure guidelines.*" *Id.*

¹²⁷ Pong Comments, at page 24.

¹²⁸ EWG notes, "Due to variations in phone design and antenna placement, moreover, the modulation of the SAR value will be case- and phone-dependent. Currently, however, most consumers are unaware of this. The FCC provides zero information that consumers can use to guide their purchasing decisions." EWG Comments, at pages 13-14.

accessories that are prevalent today—namely, cases.

V. THE FCC SHOULD REJECT ASSERTIONS THAT CONSUMERS SHOULD NOT BE PROVIDED MORE INFORMATION ABOUT WIRELESS DEVICE SAFETY.

In our September 3, 2013 filing, we noted that the FCC should update its guidelines so that consumers are provided more easily accessible information about how to reduce exposure to RF energy from wireless devices. Consumers typically remain unaware of the fine print in detailed user manuals, and therefore may not know that—by holding portable devices close to their bodies—they may be absorbing higher levels of radiation than the FCC’s safety limit permits. Ironically, within the parameters of the FCC’s RF exposure testing regulations, cell phones are governed by a so-called “general population/uncontrolled” tier—*a standard that assumes that users lack knowledge or control over potential exposure*. Because of that assumption, the safety standard dispenses with consumer warnings.¹²⁹ Yet some commenters erroneously reason that consumers remain adequately informed.

The GAO noted that user manuals typically “include a statement that, when used on the body, as opposed to against the ear, a minimum distance between the body and the mobile phone should be maintained. These distances ranged from 1.5 to 2.5 centimeters.”¹³⁰ However such statements, buried deep in device user manuals¹³¹ and FCC web site disclosures, do little to make consumers aware of potential risks and precautions. The purpose of disclosures and information is not to satisfy a legal

¹²⁹ See RF Order II, at pages 13504-05.

¹³⁰ GAO Report, at page 27.

¹³¹ For iOS 7, Apple’s disclosures regarding SAR testing appear within the software interface itself at Home>Settings>General>About>Legal>RF Exposure, at which point Apple links users to <http://www.apple.com/legal/rfexposure/iphone5,2/en/>.

obligation, but to make sure that consumers are aware. Accordingly, in our September 3, 2013 filing we recommended steps such as more prominent advisories, for example, at point of sale, on packaging, and on web sites, that would be easier for consumers to see.

One commenter in this proceeding noted that the FCC “should not mandate disclosure of SAR data of devices where emissions are below the general population RF exposure limit.”¹³² One of the problems with this premise is that, as we [and other commenters] have demonstrated in this proceeding, consumers are actually absorbing higher levels of SAR than the FCC limit, continuously, under normal operating positions or conditions. Our data, the GAO Report, and even the manuals of a leading manufacturer confirm this fact. Flawed FCC testing guidelines, and the continuous absorption of SAR levels by users above FCC limits, militate for a higher disclosure standard, particularly since most consumers are unaware of this exposure.

Another commenter who opposes providing additional consumer information states, “There is no scientific justification for mandating consumer information regarding RF exposure.”¹³³ The commenter proffers the view:

the FCC’s range of inquiry regarding consumer information as being on the verge of giving credence to areas of undue concern, particularly with regard to the questions about information for reducing RF exposure and the precautionary principle. TIA urges the FCC to be cautious about promoting the use of consumer information for reducing RF exposure and the precautionary principle: consumers often respond by believing there is a credible safety concern or else the issue would not be raised.¹³⁴

¹³² See CEA Comments, at page 6.

¹³³ TIA Comments, at page 13.

¹³⁴ *Id.*, at page 14.

First, the statement disavowing any “scientific justification for mandating consumer information regarding RF exposure” is inaccurate. The truth is, we do not know conclusively whether RF energy from wireless devices, is either safe or unsafe. But certainly numerous studies have drawn a link between RF energy and health impacts.¹³⁵ On this basis, the FCC has an obligation truthfully to tell consumers exactly that. As stated earlier, and as the GAO noted,

insufficient information was available to conclude mobile phones posed no risk. Following another decade of scientific research and hundreds of studies examining health effects of RF energy exposure from mobile phone use, **FDA maintains this conclusion. FDA stated that while the overall body of research has not demonstrated adverse health effects, some individual studies suggest possible effects. Officials from NIH, experts we interviewed, and a working group commissioned by IARC—the World Health Organization’s agency that promotes international collaboration in cancer research—have reached similar conclusions. For example, in May 2011 IARC classified RF energy as “possibly carcinogenic to humans.”**¹³⁶

Moreover, it would run counter to the public interest to withhold information that consumers are entitled to receive about RF energy, or to determine that consumers should not receive information because “consumers often respond by believing there is a credible safety concern or else the issue would not be raised.”¹³⁷ Another commenter states, in almost parental fashion, “Disclosures or advisories could confuse or alarm consumers about risks that do not exist, or worse yet numb them to warnings about risks

¹³⁵ See, e.g., footnotes 1, 3 and 39, *supra*.

¹³⁶ GAO Report, pages 6-7.

¹³⁷ TIA Comments, at page 14.

that do exist.”¹³⁸ Instead, consumers should be told the truth, and informed exactly where the science is today—which is as the GAO stated—that some (especially independently funded) studies indicate potential harms while others do not, and that neither the FCC nor any other agency can determine today with certainty that portable devices are either safe or unsafe—and, therefore, consumers should exercise reasonable precautions. The FCC has an obligation without bias to inform consumers, and to modify its guidelines accordingly.

As we and other commenters have noted, the 2011 World Health Organization/IARC report classified cell phone radiation as *possibly carcinogenic to humans*. In advocating against further disclosures to the American public, one commenter said this designation could be “distorted” by “alarmists”¹³⁹ and that the “uninitiated will tend to misunderstand this.”¹⁴⁰ The commenter then describes in contortionist fashion, their view on what the word “possibly” means:

The description “possibly carcinogenic” is oftentimes misunderstood, misused and misstated by consumers and advocates alike. Part of the confusion stems from the meaning of the word “possible.” In the IARC context, the term “possible” means “being something that may or may not occur or be true.” In other words, “possible” simply means not impossible. As the Chief of the National Cancer Institute’s Radiation Epidemiology Branch succinctly explained: possible in the IARC context just means “maybe.”¹⁴¹

These arguments essentially posit that the American people do not have the capacity to interpret for themselves what the word “possibly” means, do not have the

¹³⁸ CTIA Comments, at pages 41-42.

¹³⁹ *Id.*, at page 25.

¹⁴⁰ *Id.*, at page 43, footnote 196.

¹⁴¹ *Id.*, at pages 25-26.

right to be informed that a product is “possibly carcinogenic,” and that industry representatives are better suited to determine for the American people what information should or should not be disclosed. Such arguments contravene the public interest, and the FCC should reject them.

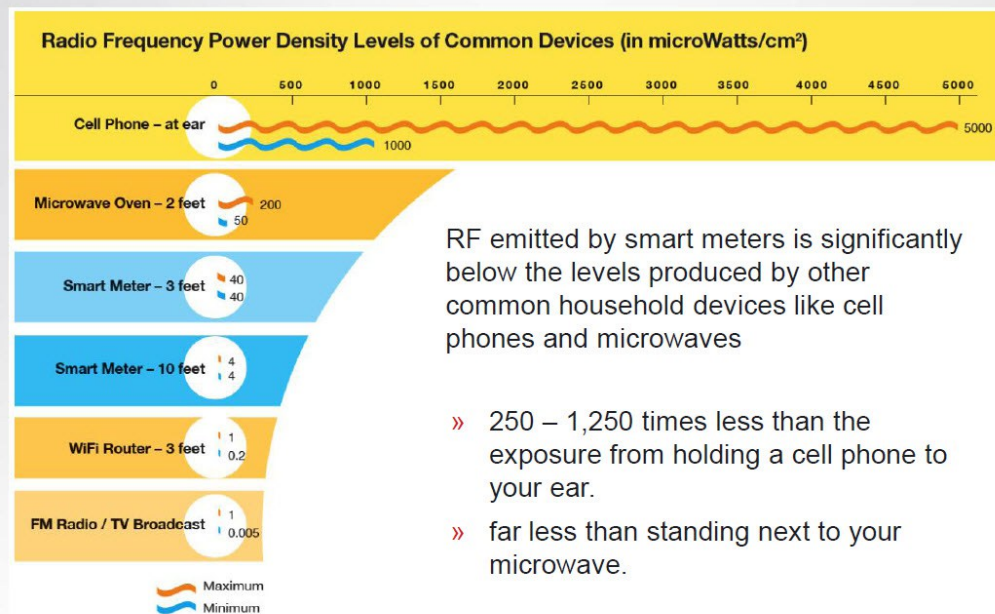
The FDA, in fact, has done just that in the instructive context of microwave ovens that subject consumers to far less RF exposure than cell phones. The FDA has the responsibility for carrying out an electronic product radiation control program mandated by the Electronic Product Radiation Control provisions of the Food and Drug Cosmetic Act.¹⁴² Through its Center for Devices and Radiological Health, FDA sets and enforces standards to ensure that radiation emissions do not pose a public health hazard, which apply to all “electronic products” that emit “electronic product radiation”—*except for cell phones*.¹⁴³ For perspective, the chart below¹⁴⁴ shows relative human exposures from cell phones and microwave ovens versus other common devices:

¹⁴² 21 U.S.C. §360i *et seq.*

¹⁴³ The Telecommunications Act of 1996 charged the FCC with adopting rules establishing a federal safety standard governing RF emissions from wireless handsets. *See* Pub. L. No. 104-204, §704(b), 110 Stat. 56 (1996).

¹⁴⁴ Electric Power Research Institute Field Measurement Study, *Radio Frequency Exposure Levels for Smart Meters, A Case Study of One Model*, February 2011.

SMART METER RF EMISSIONS VS. OTHER COMMON DEVICES



Source: Electric Power Research Institute (EPRI) Field Measurement Study "Radio Frequency Exposure Levels for Smart Meters: A Case Study of One Model, February 2011.

FDA explains on its website:

A Federal standard limits the amount of microwaves that can leak from an oven throughout its lifetime to 5 milliwatts (mW) of microwave radiation per square centimeter at approximately 2 inches from the oven surface. This limit is far below the level known to harm people. Microwave energy also decreases dramatically as you move away from the source of radiation. A measurement made 20 inches from an oven would be approximately one one-hundredth of the value measured at 2 inches.

* * * *

All ovens must have a label stating that they meet the safety standard. In addition, FDA requires that all ovens have a label explaining precautions for use. . . . Although FDA believes the standard assures that microwave ovens do not present any radiation hazard, the Agency continues to reassess its adequacy as new information becomes available.

Microwave Ovens and Health

. . . Less is known about what happens to people exposed to **low levels of microwaves**. Controlled, long-term studies involving large numbers of people have not been conducted to assess the impact of low-level microwave energy on humans. . . . **The fact that many scientific questions about exposure to low-levels of microwaves are not yet answered require [sic] FDA to continue to enforcement of radiation protection requirements. Consumers should take certain common sense precautions.**¹⁴⁵

FDA, then, takes a precautionary principle approach relative to devices that expose consumers to less RF radiation than portable wireless devices.

In other words, the United States government through the FDA (with unique public health expertise) ensures far more consumer information concerning microwave ovens—that some Americans use 30 seconds a day—than the FCC (with no public health expertise) exerts over cell phones—that substantially all Americans, even children, use regularly (even hours each day) and that have up to 100X the RF power density of microwave ovens. Americans should know that using a cell phone equates to wearing a “halo” with a 2 foot radius of 5 microwaves ovens. If one assumes that both the cell phone and ovens were operating at maximum power, that number would increase to 25 microwave ovens. SAR is directly proportional to RF power density.

VI. THE FCC SHOULD ADOPT A PRECAUTIONARY PRINCIPLE APPROACH.

The FCC should likewise adopt and encourage consumers to practice a “precautionary principle”—i.e., to take reasonable precautions to reduce exposure to

¹⁴⁵ <http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/HomeBusinessandEntertainment/ucm142616.htm#4>, emphasis added.

EMR from wireless devices.¹⁴⁶ The scientific community has not come to any final conclusions on the potential health effects of wireless device use. Recent studies have been unable to rule out adverse health impact of low-level non-ionizing RF energy, and biological effects were noted in various studies,¹⁴⁷ while other studies did not demonstrate any correlation between cell phone use and adverse health effects.¹⁴⁸ While the existing body of scientific findings has not conclusively linked cell phone radiation to cancer or other diseases in humans, it has been unable to rule out adverse health impact of low-level non-ionizing RF energy neither. Biological effects have been reported in many studies¹⁴⁹ and there is early evidence suggesting possible health risks for people with certain cell phone use patterns.¹⁵⁰ Studies are very limited on the long-term health impact of cell phones and the impact on children. The GAO Report noted that FDA and others maintain the conclusion that “insufficient information was available to conclude mobile phones posed no risk.”¹⁵¹

¹⁴⁶ The precautionary principle states that, if an activity has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is not harmful falls on those taking the action.

¹⁴⁷ See Section I(D), *supra*.

¹⁴⁸ The GAO Report stated: “Studies we reviewed suggested and experts we interviewed stated that epidemiological research has not demonstrated adverse health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have suggested a possible association with certain types of tumors, including cancerous tumors.” GAO also noted, “Overall study findings did not show an increased risk of brain tumors from mobile phone use, but at the highest level of exposure, findings suggested a possible increased risk of glioma.” GAO Report, at page 8.

¹⁴⁹ See Section I(D), *supra*.

¹⁵⁰ The GAO Report stated: “Studies we reviewed suggested and experts we interviewed stated that epidemiological research has not demonstrated adverse health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have suggested a possible association with certain types of tumors, including cancerous tumors.” GAO also noted, “Overall study findings did not show an increased risk of brain tumors from mobile phone use, but at the highest level of exposure, findings suggested a possible increased risk of glioma.” GAO Report, at page 8.

¹⁵¹ *Id.*, at page 6. In spite of this fact, the FCC states on its website: “Any cell phone at or below these SAR levels (that is, any phone legally sold in the U.S.) is a ‘safe’ phone, as measured by [current testing] standards.” See <http://www.fcc.gov/encyclopedia/specific-absorption-rate-sar-cellular-telephones>.

In his comments to the WHO classification of cell phone radiation as “possibly carcinogenic to humans,” IARC Director Christopher Wild said: “Given the potential consequences for public health of this classification and findings, it is important that additional research be conducted into the long-term, heavy use of mobile phones. Pending the availability of such information, it is important to take pragmatic measures to reduce exposure such as hands-free devices or texting.” Expert health organizations in the U.S., including the American Cancer Society (ACS), The National Cancer Institute (NCI), the FDA, the National Institute of Environmental Health Sciences (NIEHS) and the U.S. Centers for Disease Control and Prevention (CDC), share the same view that although the weight of the current scientific evidence does not establish a definitive link between cell phone use and cancer or other illnesses, more research is needed to understand the long-term effect of cell phone radiation and the effects on children.¹⁵²

One commenter states that employing a precautionary principle or “additional precautionary measures are not needed,” because “the views of the FDA and the WHO [are] that there is no public health risk from mobile telecommunications.”¹⁵³ Once again, this directly contradicts the GAO Report on FDA’s position¹⁵⁴—as well as the 2011 World Health Organization classification of cell phone radiation as “possibly carcinogenic to humans.”¹⁵⁵

The failure to adopt the precautionary principle until science conclusively proves “safety” would be seriously misleading, and against the public interest. Imagine, for

¹⁵² http://www.cdc.gov/nceh/radiation/cell_phones_FAQ.html

¹⁵³ TIA Comments, at page 9.

¹⁵⁴ See GAO Report, at pages 6-7.

¹⁵⁵ See http://www.iarc.fr/en/media-centre/pr/2011/pdfs/pr208_E.pdf.

example, a pharmaceutical company seeking FDA approval for a drug that (its benefits aside) consistently altered patients' brain glucose metabolism to unknown effect. In such a case, were the drug approved, the prudent approach would be to provide prominent consumer warnings rather than notices buried deep in product manuals. As EWG noted, "While the scientific evidence surrounding cell phone use and health effects is not definitive, there is certainly sufficient research to warrant caution."¹⁵⁶ Even *known* carcinogens can take decades to manifest themselves in terms of health effects. As we previously noted,¹⁵⁷ given this uncertainty, the GAO's conclusions that FCC's flawed testing standards likely underestimate radiation absorption by consumers, and the FCC's acknowledged lack of scientific or medical expertise in the subject matter,¹⁵⁸ the FCC should not affirmatively designate cell phones as either "safe" or "unsafe." Instead, the FCC should inform consumers that the science is inconclusive, and provide consumers with as much information as possible as to how to best exercise precautions and minimize exposure. This is precisely the type of circumstance that is appropriate for a precautionary principle approach. Indeed as EWG noted, there is a long latency to determine health impacts, and children in particular have adopted wireless devices only recently in relative terms.¹⁵⁹

¹⁵⁶ EWG Comments, at page 15.

¹⁵⁷ Pong Comments, at pages 34-37.

¹⁵⁸ See NOI Section 6.

¹⁵⁹ EWG notes, "It is important to note that brain tumors have a long latency period of 10 to 15 years. Currently available studies may not be reflective of future trends in disease, particularly in those who began using cell phones as children. It is also notable these studies detected any increase in risk, given the relatively short time periods involved. The long latency period of brain cancer creates yet another layer of uncertainty and yet another reason to implement a more stringent standard." EWG Comments, at pages 7-8, citations omitted.

VII. CONCLUSION

The FCC's equipment authorization process is designed to protect the safety and welfare of consumers. The FCC in its foresight commenced this proceeding in furtherance of these objectives, and to update the record in order to determine whether changes to the FCC's testing regime, would be prudent and advisable for the benefit of consumers. An extensive body of evidence has already been presented in this proceeding that supports such modifications.

Some commenters, however, are effectively asking the FCC to declare that cell phones are safe and, on that basis, to conclude that meaningful, substantive improvements to the FCC's testing regime are unnecessary. The FCC cannot fully serve the public interest by following these requests.

An insidious tone runs through some commenters' filings -- one that considers consumers to be "uninitiated"; incapable of determining what simple words like "possibly" means; undeserving of basic, truthful and helpful information; and unable to use and appreciate such information contextually. But consumers deserve more, and the FCC is empowered to modify the testing guidelines for the benefit of consumers.

Based on extensive evidence presented in this proceeding, the FCC should update its testing guidelines in accordance with the recommendations set forth herein and in our September 3, 2013 comments. Among these:

1. The FCC should modify its testing methodologies, including SAM specifications, more closely to simulate the physiological characteristics of children.

2. The FCC's testing guidelines should be updated to reflect use of devices directly against the body in body-worn configuration, rather than at least 15mm to 25 mm away. Most consumers hold their devices against their bodies and heads. A space of at least 15 mm dramatically impacts SAR, but that is not how consumers typically use devices. Modern habits tend towards much closer proximities, as well as longer exposures.

3. A substantial majority of wireless device users today employ cases that, unquestionably, dramatically impact SAR. The FCC should—consistent with the purposes of Bulletin 65—update its testing guidelines more accurately to reflect predominant consumer behavior. This update should incorporate testing guidelines that include the presence of a case, which would more accurately determine (among other things) the real absorption of radiation by wireless device users. The FCC should also conclude that both requiring that advisory information be more prominent and detailed and supplying accessories to the consumer could be an effective means to ensure adequate awareness and capability to ensure adherence to the SAR standards under all potential usage conditions.

4. The FCC should update its guidelines so that consumers are provided more easily accessible information about how to reduce exposure to RF energy from wireless devices. The FCC should modernize its guidelines better to inform consumers as to how to exercise precautions. These steps could include more prominent advisories, for example, at point of sale, on packaging, and on web sites, that would be easier for consumers to see.

5. The FCC should inform consumers that the science is inconclusive, and provide

consumers with as much information as possible as to how to best exercise precautions and minimize exposure, in essence adopting a “precautionary principle.” The FCC should also refrain from relaxing the safety standard, until such time as the medical and scientific research concludes that use of wireless devices in the manner that consumers including children normally use such devices, is safe. As EWG noted, *“it becomes imperative for the FCC to act. This is not because there is definitive scientific evidence pointing to harm, but rather because the consequences of a miscalculation could be severe, given the ubiquitous use of wireless technology.”*¹⁶⁰

Respectfully submitted,
PONG RESEARCH CORPORATION



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November 18, 2013

¹⁶⁰ *Id.*, at page 3.

Testing; Pong Research Corporation, Letter to the FCC; Aug. 17, 2012



August 17, 2012

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20054

Re: ET Docket 03-137/*Proposed Updates to Commission Testing Guidelines Regarding Human Exposure to Radiofrequency Electromagnetic Energy*

Dear Ms. Dortch:

On August 16, 2012, Pong Research Corporation filed a letter in FCC ET Docket 03-137. We correct herein two errors in that filing: (1) the Docket should have been referenced as "ET 03-137" rather than "WT 03-137"; and (2) the GAO should have been referenced as "Government Accountability Office" rather than "General Accounting Office." Attached is the revised filing with the corrections made.

Sincerely,

Kevin L. Passarelli

EVP Business Development and General Counsel
Pong Research Corporation

cc: Doron Gorshein
Shannon R. Kennedy, PhD
Ryan McCaughey, PhD
Rong Wang, PhD



August 17, 2012

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20054

Re: ET Docket 03-137/Proposed Updates to Commission Testing Guidelines Regarding Human Exposure to Radiofrequency Electromagnetic Energy

Dear Ms. Dortch:

The Federal Communications Commission (the “Commission”) in “Bulletin 65”¹ intended to effect a testing regime (in connection with the equipment authorization process) that replicates consumers’ actual experiences and behaviors vis-à-vis portable devices. The Commission has so stated: “For purposes of evaluating compliance with localized [Specific Absorption Rate or] SAR guidelines, portable devices should be tested or evaluated based on *normal operating positions or conditions*.”²

The United States Government Accountability Office (the “GAO”) has recently issued a report³ calling for the Commission to update its cell phone radiation exposure and testing guidelines. According to the GAO Report, the current standards—in place since 1997 (some 4 years before the first smartphones became commercially available)—“may not reflect the latest research,” “may not identify maximum exposure [to radiation] in all possible usage conditions,” and, notably, do not test for use of phones against the body—which “*could result in RF energy exposure higher than the FCC limit*.”⁴ These phenomena might particularly impact the Commission’s current SAR testing guidelines, insofar as they relate to radiation absorption by children and other vulnerable populations.

In this letter, Pong Research Corporation (“Pong”) explicates these notions of “**Real SAR**”—the SAR actually experienced by consumers using portable devices under “*normal operating positions or conditions*.”⁵ Pong also provides further information on the suitability of the

¹ In re Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Release No. 96-326, 11 F.C.C.R. 15123, 15124 (1996).

² Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, edition 97-01, August 1997, at page 42 (emphasis added), http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf. The Commission adopted the current radio frequency (“RF”) radiation exposure standards that establish a maximum SAR of 1.6 watts per kilogram (1.6 W/kg) for spatial peak SAR as averaged over any 1 gram of tissue. See 47 C.F.R. §2.1093(d)(2). All portable wireless devices marketed, distributed, or sold in the United States must comply with this limit.

³ GAO Report, *Exposure and Testing Requirements for Mobile Phones Should Be Reassessed*, GAO-12-771, July 2012, <http://www.gao.gov/assets/600/592901.pdf> (“GAO Report”).

⁴ *Id.*

⁵ Bulletin 65, at page 42.

Commission's current SAR testing guidelines, relative to the real absorption of RF radiation by children. Finally, we urge changes to the Commission's web site consistent with the GAO Report and other recent developments, in order properly to inform consumers of the potential health effects of electro-magnetic radiation ("EMR") exposure. A copy of this letter is filed in the Commission's WT Docket No. 03-137.

I. Measuring "Real SAR"

As discussed in Pong's prior filings,⁶ most consumers today rely on their devices, using and carrying them in their clothing and against their heads and bodies, for longer periods than ever before—indeed even sleeping with them⁷--such that "body worn configuration" has become not the exception but the norm.

As discussed in Pong's filing dated June 29, 2012⁸, certain testing guidelines in Bulletin 65 that account for accessories not provided by the portable device manufacturer itself—i.e., to test with a separation distance of 1.5 cm to 2.5 cm for body worn operation and in certain fixed positions for head proximity—do not accurately identify actual RF energy exposure experienced by consumers. Among other reasons, consumers do not typically keep their devices between 1.5 cm and 2.5 cm from their bodies or in fixed positions relative to their heads, but rather *against* them. As such, testing a device 15 mm or more away from the person (for body worn configuration) does not accurately reflect "real SAR."

The GAO Report similarly noted that current testing guidelines do not include testing against the body. It stated:

*"By not formally reassessing its current limit, FCC cannot ensure it is using a limit that reflects the latest research on RF energy exposure. FCC has also not reassessed its testing requirements to ensure that they identify the maximum RF energy exposure a user could experience. Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit."*⁹

To shed light on this point, Pong tested a bare iPhone 4 (i.e., without a case) in controlled laboratory conditions that simulate EMR exposure *against* the body. (See **Figure 1.**) Testing evidenced a **SAR measurement of 4.6 W/kg, well in excess of the FCC's safety standard of 1.6 W/kg.** In fact at 3 mm from the body, the device still exceeded the Commission's SAR limit.

⁶ See, e.g., filing of Pong dated 5/31/2012 in WT Docket 11-186,

<http://apps.fcc.gov/ecfs/document/view?id=7021921006>.

⁷ See <http://www.digitalbuzzblog.com/infographic-how-adults-are-using-mobile-phones> and

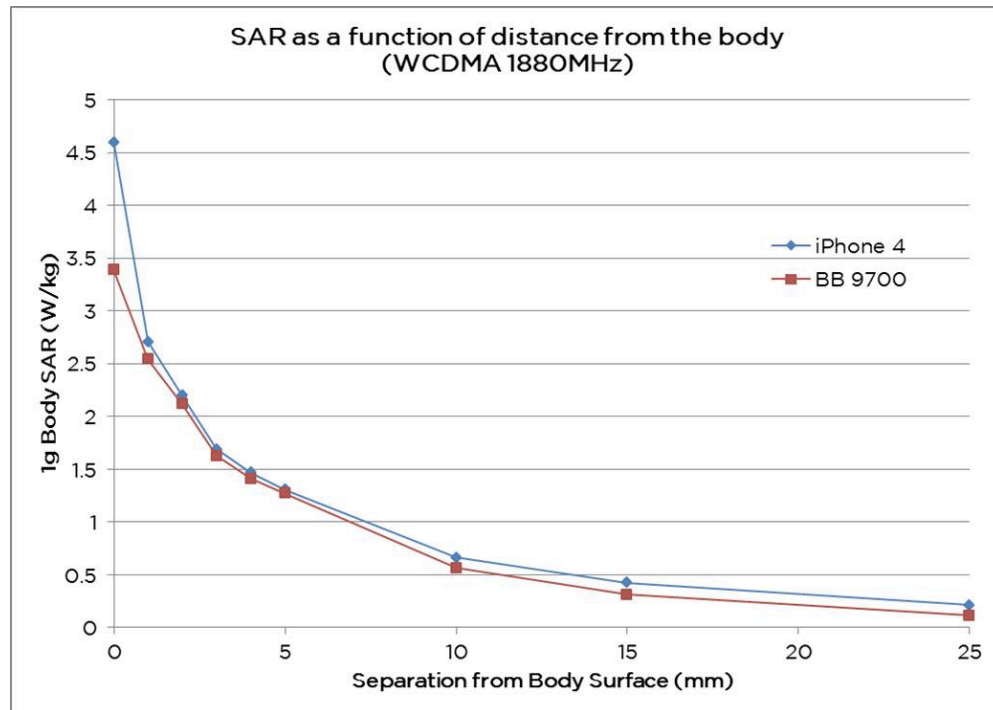
<http://www.time.com/time/health/article/0,8599,1658166,00.html>.

⁸ Filing of Pong dated June 29, 2012 in WT Docket 11-186 and ET Docket 03-137, <http://apps.fcc.gov/ecfs/document/view?id=7021981415>. See especially footnote 10.

⁹ GAO Report, *Highlights* section, emphasis added.

Results were to the same effect for a BlackBerry 9700—shown below in comparison to the iPhone 4, with *SAR at 3.4 W/kg when measured against the body*.

Figure 1. SAR Results for iPhone 4 and BB 9700 at Distances 0—25 mm at WCDMA 1880 MHz



Consumers who use certain devices¹⁰ directly against their bodies, then, might continuously experience EMR exposure at levels well in excess of the Commission’s SAR safety limit of 1.6 W/kg. We hope that other commenters in the Commission’s forthcoming notice of inquiry proceeding on cell phone safety will similarly conduct testing to shed as much light as possible on the “real SAR” resulting from the use of portable devices.

“Real SAR” from a device when measured against the body may be so high that use of a SAR-reducing case by itself may not ensure reduction of SAR below 1.6 W/kg for all phones at every spectrum band when measured at 0 mm distance from the body. We believe, however, that testing methodologies should ultimately examine the biological effects of radiation (SAR limits measure only the thermal or heating properties of devices), and encourage the Commission to inform consumers how to exercise precautions and achieve the lowest possible radiation exposures in every instance—whatever the regulatory standard.

We respectfully submit that, in order properly to protect consumers, the Commission should update its testing guidelines to include the use of devices directly against the body rather than at

¹⁰ Pong tested only selected devices at the frequencies indicated.

between 15 mm and 25 mm away.¹¹ Most consumers hold their devices against their bodies and heads. A space of at least 15 mm or more dramatically reduces SAR, but that is not how consumers typically—or, in the Commission’s words, as a matter of “*normal operating positions or conditions*”¹²—use devices. Modern habits tend towards much closer proximities, as well as longer exposures.¹³

II. The Commission Should Update its SAR Testing Guidelines to More Accurately Account for Use of Wireless Devices by Children

The Commission’s current SAR standards do not reflect the general population and, in particular, do not account accurately for the use of cell phones by children. Leading researcher Om P. Gandhi has noted:

*“[T]he existing cell phone certification process uses a plastic model of the head called the Specific Anthropomorphic Mannequin (SAM), representing the top 10% of U.S. military recruits in 1989 and greatly underestimating the [SAR] for typical mobile phone users, especially children”*¹⁴

Children are more susceptible to absorption of EMR than are adults. The SAR for a 10-year old child is up to 153% higher than the SAR for the SAM model. Gandhi noted the following:

“[RF] exposure to a head smaller than SAM will absorb a relatively higher SAR. Also, SAM uses a fluid having the average electrical properties of the head that cannot indicate differential absorption of specific brain tissue, nor absorption in children or smaller adults. The SAR for a 10-year old is up to 153% higher than the SAR for the SAM model. When electrical properties are considered, a child’s head’s absorption can be over two times greater, and absorption of the skull’s bone marrow can be ten times greater than

¹¹ Cf. Filing of Pong Research Corporation dated June 29, 2012 in WT Docket 11-186 and ET Docket 03-137, <http://apps.fcc.gov/ecfs/document/view?id=7021981417> (addressing distance standards).

¹² Bulletin 65, at page 42.

¹³ It should also be noted that operating instructions from leading device manufacturers warn users to not use cell phones close to the body. One leading manufacturer even states that *SAR may exceed allowable limits* when cell phones are held close to the body—precisely how most consumers use cell phones. The following text appears in the user “operating instructions” that the Commission approves for devices of two leading device manufacturers, in connection with the Commission’s equipment authorization process:

“iPhone’s SAR measurement may exceed the FCC exposure guidelines for bodily worn operation if positioned less than 15 mm (5/8 inch) from the body When using iPhone near your body for voice calls or for wireless data transmission over a cellular network, keep iPhone at least 15 mm away from the body...”

“Keep the [BlackBerry] device at least 0.98 inches (25mm) from your body when the [device] is turned on and connected to a wireless network. When using any data feature of the BlackBerry device . . . keep the device at least 0.98 inches from your body.”

¹⁴ Gandhi, O.P. et al., *Exposure Limits: The Underestimation of Absorbed Cell Phone Radiation, Especially in Children*, *Electromagnetic Biology and Medicine*, Early Online, 1-18 (2011).

adults.¹⁵

Gandhi proved this fact graphically¹⁶ in **Figure 2**.

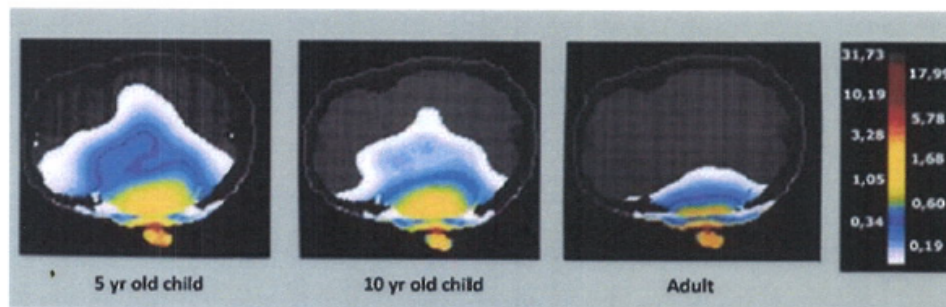


Figure 2. This figure shows SAR distributions for an adult male typical of SAM, a 10-year old child, and a 5-year old child—on the scale shown.

Frequency = 900 MHz

A February 2012 publication by Environment and Human Health, Inc., *Cell Phone – Technology, Exposures, Health Effects*, likewise noted the following:

“The model used to estimate the SAR for a cell phone user’s head was derived from the size and dimensions of the head of a large adult male. A comparison of anatomically based models of the human head shows that this SAR may underestimate the absorption rate in children by a factor of two or more. Studies show deeper penetration of absorbed energy in a child’s head, the result of the thinness of the outer ear and skull of young children.

“Experiments have shown that smaller head models produce statistically higher SAR values than larger models. The National Academy of Sciences (NAS) notes that better characterization of SARs for children of various age groups is necessary and that current models are not adequate for children.”¹⁷

Seven out of 10 children in the United States aged 10 to 14 have cell phones, and one in three teens sends more than 3,000 texts per month.¹⁸ A number of phone models are specifically marketed to children.

We respectfully suggest, therefore, that in order to best ensure protection of children, the Commission’s forthcoming notice of inquiry on cell phone safety should inquire what would be an appropriate testing methodology that would—among other things—more accurately measure “real SAR” as it relates to use of wireless devices by children.

¹⁵ *Id.*, at page 11.

¹⁶ *Id.*

¹⁷ *Cell Phone – Technology, Exposures, Health Effects*, published by Environment and Human Health, Inc., February 2012, at page 47, http://www.ehhi.org/reports/cellphones/cell_phone_report_EHHI_Feb2012.pdf.

¹⁸ *Id.*, at page 19.

III. The Commission Should Revise its Web Site so that it Does Not Affirmatively Inform Consumers that Cell Phones are “Safe”

The Commission’s web site states:

“Working closely with federal health and safety agencies, such as the Food and Drug Administration (FDA), the FCC has adopted limits for safe exposure to radiofrequency (RF) energy. These limits are given in terms of a unit referred to as the Specific Absorption Rate (SAR), which is a measure of the amount of radio frequency energy absorbed by the body when using a mobile phone. The FCC requires cell phone manufacturers to ensure that their phones comply with these objective limits for safe exposure. Any cell phone at or below these SAR levels (that is, any phone legally sold in the U.S.) is a “safe” phone, as measured by these standards. The FCC limit for public exposure from cellular telephones is an SAR level of 1.6 watts per kilogram (1.6 W/kg).”¹⁹

According to the GAO Report, the current FCC standards—in place since 1997 (some 4 years before the first smartphones became commercially available)—“may not reflect the latest research,”²⁰ “may not identify maximum exposure [to radiation] in all possible usage conditions,”²¹ and, notably, do not test for use of phones against the body. The GAO Report states: “Some consumers may use mobile phones against the body, which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit.”²²

Consumers who use certain devices directly against their bodies, then, might continuously and unknowingly experience EMR exposure at levels well in excess of the Commission’s SAR safety limit of 1.6 W/kg. (As noted above, Pong’s internal tests have confirmed such excessive exposure.) In spite of the GAO’s conclusions as well as other developments, the Commission’s web site still informs consumers that cell phones—tested by these very same standards—are “safe.” The statement is not only logically circuitous (insofar as it relies on standards that the GAO has suggested should be updated) but also confusing—as its use of quotation marks around the word “safe”²³ changes its plain meaning.

In addition to issues raised in the GAO Report regarding proximity of a device to the body during testing, the GAO Report also noted the lack of certainty with respect to health effects of cell phones: “FDA stated that while the overall body of research has not demonstrated adverse health effects, some individual studies suggest possible effects.”²⁴ With respect to potential health impact from cell phone use, the GAO Report stated “the research is not conclusive because findings from some studies have suggested a possible association with certain types of

¹⁹ <http://www.fcc.gov/encyclopedia/specific-absorption-rate-sar-cellular-telephones> (emphasis added).

²⁰ GAO Report, *Highlights* page.

²¹ *Id.*

²² *Id.* Further, the GAO Report states on page 26, that “Some consumer groups noted that they would like FCC to mention IARC’s recent classification of RF energy exposure as ‘possibly carcinogenic’ on FCC’s website.”

²³ See <http://www.fcc.gov/encyclopedia/specific-absorption-rate-sar-cellular-telephones>.

²⁴ *Id.*, at page 6.

tumors, including cancerous tumors.”²⁵ The GAO Report further stated that FDA and others maintain the conclusion that “*insufficient information was available to conclude mobile phones posed no risk.*”²⁶ This fact would appear to contradict an affirmative designation that cell phones are “safe.”²⁷ The lack of certainty with respect to the health effects of cell phones further supports the need for the Commission to revise its web site in order better to inform consumers.

We suggest that a more supportable and protective consumer notification would indicate that: (a) the Commission established guidelines that it believes were suitable given the available data at the time; (b) the Commission expects to commence an inquiry that, among other things, will examine whether changes need to be made to the Commission’s testing regime; and (c) in the interim, consumers should at all times exercise caution with respect to use of cell phones.

Conclusion

The Commission’s testing guidelines aim to protect the safety and welfare of consumers, including children. To safeguard the continued integrity of the testing regime that underlies the equipment authorization process, and properly to promote consumers’ safety and welfare, the Commission should—consistent with the purposes of Bulletin 65—update its testing guidelines more accurately to reflect predominant consumer behavior. Testing guidelines should be updated to reflect use of devices directly against the body rather than at least 15 mm away.

In addition, testing methodology, including SAM specifications, should be modified more closely to simulate the physiological characteristics of children, in order better to measure their potential SAR exposures.

Until further study is completed and the Commission’s testing guidelines are updated, however, the Commission should *not* affirmatively inform consumers that cell phones are “safe” or safe. We respectfully proffer that it is no longer empirically supportable given the scientific uncertainty, nor sound from a consumer protection perspective, to notify consumers that cell phones are safe according to Commission standards (which themselves require updating).

The Commission should implement testing standards that reflect “real world” usage patterns, protect vulnerable populations such as children, consider the biological effects of radiation in testing methodology, and encourage and inform consumers on how to exercise precautions and achieve the lowest possible radiation exposures. By updating its testing guidelines and providing more information to consumers, the Commission can continue to promote consumer safety, consumer awareness, and wireless service quality.

²⁵ *Id.*, at page 8.

²⁶ *Id.*, at page 6.

²⁷ Further, and again in apparent contradiction to the GAO’s conclusion that “*insufficient information was available to conclude mobile phones posed no risk,*” on June 15, 2012 various press sources reported that an FCC spokesperson stated, ““We are confident that, as set, the emissions guidelines for devices *pose no risks to consumers.*” [Emphasis added]

Thank you for your consideration of these matters.

Sincerely,



Kevin L. Passarelli

EVP Business Development and General Counsel
Pong Research Corporation

cc: Doron Gorshein
Shannon R. Kennedy, PhD
Ryan McCaughey, PhD
Rong Wang, PhD

Environmental Health Trust, Reply Comments (Erroneous Comments Submitted to the FCC on Proposed Cellphone Radiation Standards and Testing by CTIA – September 3, 2013), Nov. 17, 2013

FCC 13-39

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of

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Reassessment of Federal Communications
Commission Radiofrequency Exposure Limits and
Policies

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)
)
)

ET Docket No. 13-84

Proposed Changes in the Commission's Rules
Regarding Human Exposure to Radiofrequency
Electromagnetic Fields

)
)
)
)

ET Docket No. 03-137

To: Office of the Secretary
Federal Communications Commission
Washington, DC 20554

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November 18, 2013

**Erroneous Comments Submitted to the FCC on Proposed
Cellphone Radiation Standards and Testing
by CTIA – The Wireless Association, September 3, 2013**

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Executive Summary

We document numerous errors of fact and interpretation in the CTIA Comments:

- **CHILDREN’S EXPOSURE:** Contrary to CTIA’s assertions that the current standard adequately protects children, pregnant women and other vulnerable groups, the exposure limits recommended in the past three decades have consistently singled out children’s exposure as requiring special consideration and attention.
- **“HARMONIZATION”:** The CTIA states the need to increase exposure under the rubric of international “harmonization” of the standard which would result in as much as a 3-fold increase in the maximum allowed absorption of microwave radiation.
- **FIFTY-FOLD SAFETY FACTOR:** The CTIA assertion that the current standard relies on a fifty-fold safety factor is incorrect. It is only 2.5 times higher than a potential irreversible effect.
- **STATE OF THE SCIENCE:** We counter the CTIA assertion that International Agency for Research on Cancer of the World Health Organization (IARC) declaration that cellphone and other wireless device radiation is a possible human carcinogen “does not change the state of the science.”
- **CERTIFICATION PROCESS:** We disagree with the CTIA’s assertion that there is only one FCC approved cellphone certification process. There are two FCC approved processes: Computer Simulation and SAM⁹. Computer simulation is far superior to SAM. Unfortunately the computer simulation process has never been used to certify that wireless devices meet the exposure limits although the FDA helped to develop it and currently relies on it to evaluate and approve medical devices.
- **CONFLICTS-OF-INTERESTS:** Documents that many of the organizations and individuals cited as authorities by the CTIA have direct ties to the telecommunications industry and are often funded by the industry.
- **BRAIN CANCER RATES:** We counter the CTIA assertion that brain cancer incidence rates are stable when in fact brain cancer incidence increased in 4 countries, and for 3 of these 4 countries glioblastoma has doubled, in the last decade or less.
- **EXPOSURE:** Shows how “normal operation positions” of wireless devices can result in exposures of more than 2 orders of magnitude higher than the

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⁹ Specific Anthropomorphic Mannequin

exposure limits and bone marrow in children's skulls absorb 10-fold greater radiation than adult's marrow.

- ADVERSE HEALTH EFFECTS: The CTIA selectively reviews the science, more often than not, incorrectly, while myriad studies published after the adoption of the current FCC exposure limits which show adverse health effects, particularly cancers contradicting CTIA's assertions.
- ANIMAL STUDIES: CTIA assertions implying that evidence from animal studies is contradicted by listing of animal studies that found adverse effects and was used by IARC for its declaration of a "possible carcinogen."

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Introduction

Originally, CTIA was the Cellular Telecommunication Industry Association, and transformed itself into CTIA—The Wireless Association. The original name remains a correct appellation. Its [members](http://www.ctia.org/membership/ctia_members/) include 28 carrier companies, 109 “Sub-GM Members” (mostly suppliers and cellphone manufacturers), and 103 Associate Members.¹⁰ As such the CTIA has a vested interest in portraying its information in a manner that would optimally benefit its members.

As will be cited throughout this response CTIA’s Comments are often incorrect, and/or incomplete and/or misleading. They selectively review information that is compatible with their proposals to weaken current standards by allowing up to 3-fold increased microwave radiation, and they systematically ignore studies that show that current standards do not adequately protect public health or the environment.

The focus of this response, prepared by experts in public health, will be on children’s substantially larger absorption of microwave radiation, the inability of the currently used wireless device certification process to account for specific tissue types (e.g., bone marrow) that absorb greater radiation than adults, and children’s wearing of metal eyeglasses, jewelry and piercings, leading to the urgent requirement to adopt new exposure limits that recognizes this real-world realities.

The History of Exposure Standards

The CTIA Comments references standards by ANSI¹¹ (1982), NCRP¹² (1986), IEEE¹³ (1991), ANSI/IEEE¹⁴ (1992), FCC Bulletin 65 (1997) and its Supplement C (2001), ICNIRP¹⁵ (1998), and IEEE (2005)¹⁶. Yet, the CTIA ignores statements contained within these documents that constitute the concerns, warnings, and specific details for protection of the most vulnerable member of our nation.

¹⁰ http://www.ctia.org/membership/ctia_members/ (accessed 5 Nov. 2013).

¹¹ ANSI: American National Standards Institute

¹² NCRP: National Council of Radiation Protection

¹³ IEEE: Institute of Electrical and Electronic Engineers. A professional organization of industry engineers and academics whose works supports industry

¹⁴ This standard is identical to IEEE 1991.

¹⁵ ICNIRP; International Commission on Non-Ionizing Radiation Protection

¹⁶ CTIA refers to it variously as IEEE 2006 and IEEE 2005. IEEE 2005 is correct.

ANSI 1974

The chairman of the Subcommittee that created this document was Arthur W. (Bill) Guy. Other members were: John Osepchuk and Ron Peterson. For more information see **Credibility of Sources**, Individuals below.

This standard was very short, only two pages (title and authors excluded). It defined an exposure limit for power density¹⁷ equal to 10 mW/cm² averaged over 6 minutes.

It did report several factors of concern.

Concerns

1. The authors noted “People who suffer circulatory difficulties and certain other ailments are more vulnerable,” adding, “Under conditions of moderate to severe heat stress the guide number should be appropriately reduced.”
2. The last section, “Whole Body Irradiation and Partial Body Irradiation” states “These formulated recommendations pertain to both whole body and partial body irradiation. Partial body must be included since it has been shown that **some parts of the human body (for example the eyes and testicles may be harmed if exposed to incident radiation levels significantly in excess of the recommended levels [emphasis added].**”
3. It states, “It is the present consensus that thermal effects are considered to be the most harmful and the therefore have been used as the basis for establishing the levels in this standard. Sufficient information concerning modulation effects, peak power effects, field strength effects, or frequency dependencies and limits are not currently available to substantiate adjustments of the radiation protection guide to account for these effects.”

The U.S. Occupational Safety and Health Administration (OSHA) adopted this and a previous 1966 standard.¹⁸

In fact, all subsequent standards no longer required that whole-body and partial body irradiation levels be the same. Indeed, the partial body irradiation was henceforth allowed to be 20-fold higher than is allowed for whole-body irradiation.

¹⁷ Power density is the radiated power found within a cross-sectional area.

¹⁸ Microwave News, May 1981, p. 4.

ANSI 1982

As with the ANSI 1974 the chairman of the subcommittee that produced the standard was Dr. Arthur W. (Bill) Guy.

This standard was based on the ANSI 1974 standard. The starting point to establish an exposure limit was what whole-body exposure level *hungry* rats previously trained to find food ceased trying to find food. The ANSI committee stated, “[R]eliable evidence of hazardous effects is associated with wholebody-averaged SARs above 4 W/kg.” Yet they also stated “The assumption is that reversible disruption during an acute exposure *is tantamount to irreversible injury* during chronic exposure.” (ANSI, 1982, p. 13) [*emphasis added*]. In other words, because these behavioral changes occur during a short (acute) exposure, they can be assumed to cause irreversible damage with a continuous (chronic) exposure.

ANSI then arbitrarily established a 10-fold safety factor, dividing the whole-body SAR which was “tantamount to irreversible injury”—resulting in $SAR_{WB}^{19}=0.4$ W/kg ANSI, 1982, p. 13-14).

But, in fact, the level they used to calculate this “safety” factor was 4 times higher than the level at which rats ceased seeking food. A 1975 study, known but ignored by the ANSI Committee, found that the cessation of efforts to find food occurred at a whole-body $SAR_{WB}=1$ W/kg²⁰, *not at 4 W/kg*. As will be seen in the response to CTIA’s assertion that there is a 50-fold safety factor, this study is important (see **Fifty-Fold Safety Limit Is Specious** below).

ANSI adopted a standard for whole body exposure of 0.4 W/kg averaged over 6 minutes, and a 20-fold greater spatial peak SAR^{21} exposure over any 1 gram of tissue of 8 W/kg averaged over 6 minutes. This fundamental change allowed a 20-fold higher exposure into the brain than into the rest of the body.

There was no logical explanation why the brain should be allowed to absorbed 20-fold more radiation than the whole-body, but the Committee did supply an explanation:

¹⁹ SAR_{WB} : Whole body SAR is applicable in the far-field where the whole body is absorbing the incident radiation.

²⁰ J. A. D’Andrea, O. P. Gandhi, R. P. Kesner. Behavioral effects of resonant electromagnetic power absorption in rats. Biological Effects of Electromagnetic Waves, Selected Papers of the USNC/URSI Annual Meeting, Boulder, Colorado, October 20–23, 1975.

²¹ Spatial peak SAR is applicable in the “near-field” where the radiation is only absorbed by a portion of the body as when a cellphone is held to the ear. In contrast, whole body SAR is applicable in the “far-field” where the radiation impacts the whole body.

“By implication and demonstration, peak SARs in a biological body can *range more than an order of magnitude above the average SAR over a* limited mass of the exposed tissue.”

Rather than reducing whole-body SAR by a factor of 20 because “peak SARs can range more than an order of magnitude” higher, they chose to allow a 20-fold high peak SAR.

The most important change was the exclusion of any hand-held device transmitting less than 7 Watts of radiation.²² The potential effect of this exclusion would be that no U.S. government agency such as the FDA or EPA could require pre-market safety testing of wireless devices. At this time (1981), Motorola, with millions of “walkie-talkies” that radiated less than 7 Watt in use, was protected. This exclusion was variously referred to as the “low power exclusion” or as the “Motorola exclusion.”

“Dr. Quirino Balzano of Motorola ... [was] pleased: ‘The standard now recognizes that, in the near field, high electric field readings do not necessarily cause biological effects.’”²³ Nine years earlier, April 3, 1973, a senior executive at Motorola, Martin Cooper had placed the first cellphone call to its major competitor, AT&T.²⁴ In effect, this could have been a gift in the for the nascent cellphone industry, had the FCC not removed this exclusion when it adopted its 1996 exposure rules.

As the ANSI 1982 standard approached final approval the Environmental Protection Agency registered its disapproval. Dave Janes with the EPA stated, “My position has already been made clear, and it has not changed.”²⁵

The ANSI Committee expressed concern that important factors were not considered:

Concerns

1. “It was recognized that the specific absorption rate (SAR), which provides the basis for limiting power densities, does not contain all of the factors that could be of importance in establishing safe limits of exposure. First, other characteristics of an incident field such as *modulation frequency* and *peak intensity* may pose a risk to health [*emphasis added*].”

²² ANSI 1982, p. 10.

²³ Microwave News, May 1981, p. 4.

²⁴ Devra Davis, Disconnect, p.41.

²⁵ Microwave News, October 1981, p. 7

2. There are clear warnings that within an averaged SAR for a smaller volume of tissue, there will inevitably be “hotspots” well above the averaged SAR over a larger volume. As ANSI noted, “[A] whole-body-averaged SAR is the mean of a distribution, the high side of which is an envelope of electrical hotspots.” The discussion continues, “Because of the invariable presence of electrical hotspots in the irradiated body and the inherent correlation between magnitudes of whole-body and part-body SARs, a biological effect induced by a localized SAR that is well above the whole-body average will be reflected to some extent by that average [ANSI 1982, p. 14].”

For more information see **FCC’s Two Cellphone Certification Processes, The Average Tissue Volume Is a Major Factor in Determination of SAR** below.

3. The Committee noted, “In addition, **modulation-specific effects, such as efflux of calcium ions from brain materials were not considered adverse because of the inability of the subcommittee’s members to relate them to human health**²⁶. The narrow ranges of power density and the low and narrow range of modulation frequencies associated with field-induced efflux of calcium ions, and the authors’ findings that the phenomenon is reversible, are factors that entered into the subcommittee’s deliberations [ANSI 1982, p. 13, **emphasis added**].”

This statement reflects the absence of biological expertise on the ANSI Subcommittee 32 years ago, regarding the now well-known critical importance of calcium homeostasis in cells and that electromagnetic radiation impacts calcium homeostasis (e.g., Blackman et al. 1991,²⁷ Anghileri et al. 2005,²⁸ Yan et al. 2008 and 2009,²⁹ Maskey et al. 2010,³⁰

²⁶ The inability to relate the effect of calcium ion efflux from brain cells to human health speaks of the lack of biological knowledge on the Committee.

²⁷ Blackman CF, Benane SG, House DE (1991). The influence of temperature during electric- and magnetic field-induced alteration of calcium-ion release from in vitro brain tissue. *Bioelectromagnetics*, 12: 173–182. doi:10.1002/bem.2250120305 PMID:1854354.

²⁸ Anghileri LJ, Mayayo E, Domingo JL, Thouvenot P (2005). Radiofrequency-induced carcinogenesis: cellular calcium homeostasis changes as a triggering factor. *Int J Radiat Biol*, 81: 205–209. doi:10.1080/095553000500076957 PMID:16019929.

²⁹ Yan JG, Agresti M, Zhang LL et al. (2008). Upregulation of specific mRNA levels in rat brain after cell phone exposure. *Electromagn Biol Med*, 27: 147–154. PMID:18568932.

Yan JG, Agresti M, Zhang LL et al. (2009). Qualitative effect on mRNAs of injury-associated proteins by cell phone like radiation in rat facial nerves. *Electromagn Biol Med*, 28: 383–390. PMID:20017629

³⁰ Maskey D, Kim M, Aryal B et al. (2010). Effect of 835 MHz radiofrequency radiation exposure on calcium binding proteins in the hippocampus of the mouse brain. *Brain Res*, 1313: 232–241. PMID:19968972.

Donnellan et al. 1997,³¹ Bawin et al. 1975 and 1978,³² Blackman et al. 1980,³³ Dutta et al. 1984, and 1989,³⁴ and Schwartz et al. 1990³⁵).

As calcium has been understood to be vitally important to the functioning of membranes and transport of energy, the assertion by the Committee in 1982 that this demonstrated impact of radiation on calcium efflux does not have health consequences was wrong at the time and is even more wrong at this point in scientific history.

Thus, contrary to CTIA's 19 assertions that that non-thermal effects do not exist, a number of studies reported non-thermal adverse biological effects from electromagnetic radiation several years ago.

NCRP 1986

The Report was published almost 3 decade ago. CTIA's first comment on NCRP involvement with the current FCC exposure limits states "The Commission revised its RF emission standards in 1996, adopting limits based on guidelines from the National Council on Radiation Protection and Measurements (NCRP) and the 1992 ANSI/IEEE C95.1 standard" [CTIA Comments p. 5] and has a further 10 comments concerning NCRP, particularly in stating that there was no evidence of non-thermal effects from exposure to electromagnetic radiation (EMR). As will be seen below, this is not true.

Non-thermal effects (no measurable temperature change)

The NCRP 1986 uses both the term "athermal," and the term "non-thermal" for results that have no measurable temperature change.

³¹ Donnellan M, McKenzie DR, French PW (1997). Effects of exposure to electromagnetic radiation at 835 MHz on growth, morphology and secretory characteristics of a mast cell analogue, RBL-2H3. *Cell Biol Int*, 21: 427–439. doi:10.1006/cbir.1997.0162 PMID:9313343.

³² Bawin SM, Kaczmarek LK, Adey WR (1975). Effects of modulated VHF fields on the central nervous system. *Ann N Y Acad Sci*, 247: 1 Biologic Effe74–81. doi:10.1111/j.1749-6632.1975.tb35984.x PMID:1054258.

Bawin SM, Sheppard A, Adey WR (1978). Possible mechanisms of weak electromagnetic field coupling in brain tissue. *Bioelectrochem Bioenerg*, 5: 67–76. doi:10.1016/0302-4598(87)87008-3.

³³ Blackman CF, Benane SG, Joines WT et al. (1980). Calcium-ion efflux from brain tissue: power-density versus internal field-intensity dependencies at 50 MHz RF radiation. *Bioelectromagnetics*, 1: 277–283. doi:10.1002/bem.2250010304 PMID:7284026.

³⁴ Dutta SK, Ghosh B, Blackman CF (1989). Radiofrequency radiation-induced calcium ion efflux enhancement from human and other neuroblastoma cells in culture. *Bioelectromagnetics*, 10: 197–202. doi:10.1002/bem.2250100208 PMID:2540756.

³⁵ Schwartz JL, House DE, Mealing GA (1990). Exposure of frog hearts to CW or amplitude-modulated VHF fields: selective efflux of calcium ions at 16 Hz. *Bioelectromagnetics*, 11: 349–358. doi:10.1002/bem.2250110409 PMID:2285418.

The NCRP Report states:

“[A]fter acute exposure to relatively very-low-intensity, sinusoidally modulated shortwave and microwave fields (cf., e.g., Bawin et al. 1975; Blackman et al., 1980, Adey, 1980) [are found]. In experiments in which isolated chicken brains were exposed to CW fields or to fields modulated at 3 to 30 Hz, an exodus of calcium ions (Ca^{2+}) from brain materials was observed, but only to modulated fields within a narrow band of frequencies centered near 15 Hz-and only within a narrow range of power densities. Because the average amount of energy captured by brain materials was held constant across frequencies, thermal effects alone could not be responsible for the release of Ca^{2+} . These intriguing experiments are discussed in detail in Section 11 [p. 5].”

In Section 11, contrary to the CTIA claim, the NCRP does not deny “athermal” effects. Rather the NCRP authors effectively describe all effects including those with no measureable temperature change as thermally induced effects. They explain this reasoning as follows:

“As an indicant of an effect that is associated with quantities of energy absorbed rather than with quantities of incident energy across a sizable span of species and carrier frequencies, behavioral incapacitation has served as a highly useful criterion and benchmark in the formulation of protective exposure limits. These virtues notwithstanding, the end point of incapacitation (or of any dependent variable based solely on behavior) has a weakness that lies in its empirical rationale-no distinction can be made between thermal effects and effects arising from athermal events, or from thermal-athermal complexing-and in the corollary matter of mechanisms (p. 185).”

Thus the NCRP authors engage in a semantic argument which obfuscates the issue. Basically they contend that if an effect occurs in the absence of a measured change in temperature a non-measurable temperature change exists. NCRP does not challenge the reality that adverse effects have been found over a wide-range of experiment where there is no measurable temperature change. The greater scientific community uses non-thermal effects to mean effects which are found where there is no measurable temperature difference. The CTIA Comments ignore this semantic difference and declare in multiple ways,

“The FCC’s RF standards, which are based on the ANSI/IEEE and NCRP recommendations, account for non-thermal effects. In

promulgating their standards, both ANSI and NCRP considered non-thermal effects but determined the scientific data on this point was unreliable [CTIA Comments, p. 13-14].”

This interpretation by the CTIA is most emphatically a misreading of the NCRP Report, as these excerpts indicate:

On page 7 of the NCRP Report the authors state, “As a point of departure in the discussion of mechanisms, it can be stated that **there is ample evidence that athermal interactions in biological materials are not only possible but have been demonstrated for fields both strong and weak**. It must also be stated that the biophysical mechanisms of these athermal events are but poorly understood [**emphasis added**].”

On page 24, “The weight of the evidence is that, with the exception of calcium efflux experiments, reported elsewhere in this report, athermal effects of microwave power on cellular function are difficult to demonstrate.”

The NPCR Report provides a definition of “dose” in the context of radio frequency radiation (RFR). On page 275, “dose” is the Specific Absorption (SA), and the “dose-rate” is Specific Absorption Rate (SAR). Thus the “dose” is the time in seconds multiplied by the “dose-rate” (SAR), and the resultant units of dose are Joules per kilogram (J/kg) or per the Système Internationale d’Unités (SI), or International System of Units, the formal unit of measure is Gray (Gy), 1 j/kg=1 Gy. For the importance of these definitions see **Fifty-fold Safety Limit Is Specious**, Five-fold safety factor for general public does not exist, section below.

IEEE 1991

In 1987-1988, ANSI, concerned about its lack of medical expertise, “handed over the setting of exposure limits to the Institute of Electrical and Electronic Engineers (IEEE)”³⁶. However, the IEEE also lacked medical expertise as well as public health expertise.

Many of the Subcommittee members who approved this standard were telecommunication industry employees.

Among these employees were:

Q. Balzano

³⁶ Gandhi OP, Morgan LL, de Salles AA, Han Y-Y, Herberman RB, Davis DL. Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children. *Electromagnetic Biology and Medicine*, 31(1): 34–51, 2012.

Arthur W (Bill) Guy
M. (Mays) L. Swicord
Ron Petersen

For details on these individuals see **Credibility of Sources**, Individuals below.

This exposure standard, adopted in part by the FCC in 1996, and based on the ANSI 1982 standard, made changes which *appeared to reduce* the maximum exposure dose for the general public in “uncontrolled environments” compared to an *apparently* higher exposure dose for electric workers in “controlled environments”,³⁷ but in fact under the changed standard both groups are exposed to *the identical radiation dose*.

IEEE 1991 reduced the dose-rate (SAR) for the general public by a factor of 5, while leaving SAR for electrical worker unchanged. Thus, for the general public maximum $SAR_{WB}=0.08$ W/kg and for workers maximum $SAR_{WB}=0.4$ W/kg; equivalently, the spatial peak was $SAR=1.6$ W/kg and $SAR=8$ W/kg, respectively.

But contrary to any logic, the previous averaging time, which was 6 minutes was increased 5-fold to 30 minutes for the general public. Thus as stated above the radiation dose was the same for the general public and electrical workers ($1.6\text{W/kg}\cdot 30\text{ minutes}=2.88\text{ kJ/kg}=2.88\text{ Gy}$, and $8\text{W/kg}\cdot 6\text{ minutes}=2.88\text{ kJ/kg}=2.88\text{ Gy}$). Put simply, for the general public the dose-rate was reduced 5-fold and the dose was increased 5-fold, resulting in no difference. For more information see **Fifty-fold Safety Limit Is Specious** below.

For electrical workers the exposure limits for extremities (e.g., hands, feet, wrists, ankles, and by a recent FCC declaration, to the ear as well) is 20 W/kg; for the general public it is 4 W/kg, each case averaged over any 10 grams of tissue. The eyes and testes are specifically excluded from this requirement.

Though extremities are not explicitly defined, this would include the arms and legs. No rationale is provided for this high exposure. The leg is never mentioned but for an arm it states, for “exposure of a triple layered (fat-muscle-bone) cylindrical arm model with the E field both perpendicular and parallel to the axis of the cylinder. (The results of the analyses where the E field is parallel

³⁷ IEEE 1991, p. 9, “Controlled environments are locations where there is exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment.”

to the axis of the cylinder are valid only where the arm model is equal or greater than one half wavelength.) The overall results of these analyses support the recommended peak exposure values as worst-case levels [p.26].”

IEEE 1991 also expressed concern for “subgroups of greater sensitivity.”

Concern

“To some, it would appear attractive and logical to apply a larger, or different, safety factor to arrive at the guide for the general public. Supportive arguments claim *subgroups of greater sensitivity (infants, the aged, the ill and disabled), potentially greater exposure durations (24-hr/day vs. 8-hr/day), adverse environmental conditions (excessive heat and/or humidity), voluntary vs. involuntary exposure*, and psychological/emotional factors that can range from anxiety to ignorance. Non-thermal effects, such as efflux of calcium ions from brain tissues, are also mentioned as potential health hazards [p. 14, *emphasis added*].”

The CTIA Comment denies the existence of non-thermal effects 13 times,³⁸ and yet it never mentions calcium efflux, which has been a well-established non-thermal effect for many decades.

ANSI/IEEE 1992

In November 1992 ANSI endorsed IEEE 1991. Other than title changes referring to ANSI, ANSI/IEEE 1992 is identical to IEEE 1991.

However in a Microwave News article titled “EPA Assails ANSI RF/MW Standards as Seriously Flawed,” both the EPA and the FDA made strong objections to the FCC’s exposure limit adoption.³⁹

The EPA’s objections included, “the standard has “serious flaws” and questioning whether it is ‘sufficiently protective of public health and safety.’ ... in particular, the standard’s different limits for ‘controlled’ and ‘uncontrolled’ environments and the failure to consider nonthermal effects.”

The EPA recommended to the FCC that:

³⁸ Page 15—3 times, page 16—4 times, page 50—4 times, page. 51, and page. 53.

³⁹ Microwave News, January/February 1994, p. 10.

“The FCC should not adopt the 1992 ANSI/ IEEE standard. There are serious flaws in the standard that call into question whether the proposed use of 1992 ANSI/IEEE is sufficiently protective.” It listed 4 concerns:

1. “1992 ANSI/IEEE allows a twofold increase in the [maximum permissible exposures] at high frequencies above that permitted by the current FCC guideline;”
2. “The two-level revised standard is not directly applicable to any population group but is applicable to exposure environments called controlled and uncontrolled environments that are not well defined and are discretionary. We disagree with this approach;”
3. “The 1992 ANSI/IEEE conclusion that there is no scientific data indicating that certain subgroups of the population are more at risk than others is not supported by NCRP and EPA reports;”
4. “The thesis that the 1992 ANSI/IEEE recommendations are protective of all mechanisms of interaction is unwarranted because the adverse effects level in the 1992 ANSI/IEEE standard is based on a thermal effect.”

The FDA had a single objection, “[O]ne provision with which we must disagree.... The concept of limiting the SAR induced in the body appears to be disregarded... [by] a ‘low-power exclusion clause’ that exempts certain RF devices from the provisions of the standard only because they emit less than a specified amount of power. Recent data from technical publications and other sources indicate that certain lower-powered RF devices, such as hand-held, portable, two-way radios, cellular phones, and other personal communication devices can induce relatively high SARs in portions of the body of nearby persons. Indeed, some devices that meet the requirements of the low-power exclusion clause can induce SARs that exceed the local-SAR limits specified elsewhere in the same standard—making the standard appear self-contradictory....”⁴⁰

The FDA also stated, “In addition, we recommend that the scientific literature be closely monitored for possible evidence that the exposure levels cited by the new standard may need to be reduced.... In our view, the adoption of the 1992 ANSI standard furthers, but does not end, our respective RF protection efforts.”

There is little to no evidence that close monitoring of the scientific literature has occurred in the intervening years.

⁴⁰ Microwave News, January/February 1994, p. 10.

A 3-page Microwave News article, “Industry Urges FCC Adoption of ANSI/IEEE C95.1-1992” cites views from industry, one U.S. governmental agency and an organization of amateur (HAM) radio operators.⁴¹

The U.S. agency was the National Institute for Occupational Safety and Health (NIOSH) which was “concerned about the lack of participation by experts with a public health perspective.” NIOSH also was concerned about the adequacy of workers “controlled environment” exposure and stated, “the conservative public health approach would be to adopt only the more restrictive ‘uncontrolled environment’ limits for all exposed workers and the general public.”

The American Radio Relay League (HAM radio operators) stated, “There is in the ANSI/IEEE 1992 standard no stated justification for the standard for the ‘uncontrolled’ environment, or for the decision to utilize a safety factor of 50...”

Here are a few excerpts from some of industry’s comments:

AT&T: “[B]ecause emissions from some Part 15 devices and hand-held terminals of various kinds may exceed the new limits, categorical exclusion of these types of equipment would not be appropriate”

CTIA: “It is not necessary or appropriate to require manufacturers to submit detailed data relative to this [exposure limit] measurement ...”

FAA: “FAA will make no distinction between ‘controlled’ and ‘uncontrolled’ environments in the application of permissible exposure limits for [RF] protection.”

Motorola: “It may be necessary in some cases, such as for cellular telephones, to routinely measure the [SAR] because the 2.5 cm spacing requirement for application of this exclusion is not met.”

FCC Bulletin 65 1996 and its Supplement C 1997

As reported in Microwave News, on April 6, 1996 the new FCC regulations went into effect. The rules were based both on the NCRP and the ANSI/IEEE 1992 documents.⁴² The FCC rejected the “low power exclusion,” and required “[C]ompliance...be shown with laboratory measurements or by computer modeling,” accepting the “occupational” and “general population” exposure differences.

⁴¹ Microwave News, May/June 1994, p. 13-15.

⁴² Microwave News, July/August 1996, “FCC RF/MW Rules Favor NCRIP Limit; Cell Phnes To Be Tested for Safety, p. 1.

Bulletin 65 “has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to radiofrequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance [p. 1].”

On the page following where the authors are listed, it states, Supplement C “is issued in connection with FCC’s OET Bulletin 65, Version 97-01. The information in the supplement provides additional guidance for use by applicants for FCC equipment authorization in evaluating mobile and portable devices for compliance with the FCC’s guidelines for human exposure to radiofrequency (RF) electromagnetic fields.”

The CTIA Comments asserts “Since 2002, the Commission’s sole pre-approved method for testing has been through the IEEE-recommended specific anthropomorphic mannequin (SAM) [p. 6].” This assertion is false. Supplement C in the section, SAR Computation Guidelines and Descriptions (p. 16-18) states,

“Currently, the finite-difference time-domain algorithm is *the most widely accepted computational method for SAR modeling*. This method adopts very well to the tissue models which are usually derived from MRI or CT scans, such as those available from the *visible man project*. FDTD offers great flexibility in *modeling the inhomogeneous structures of anatomical tissues and organs*. The FDTD method has been used in many far-field electromagnetic applications during the *last three decades*. With recent advances computing technology, it has become possible to apply this method to near-field applications for evaluating handsets [p. 16, *emphasis added for context provided in the FCC’s Two Certification Processes section below*].”

Supplement C was published in December 1997. *Three decades* previously this computer simulation process was in use (close to 5 decades from the present). Seventeen years ago this was *the most widely accepted computational method for SAR modeling*. Seventeen years previously, it offered great flexibility in *modeling inhomogeneous structures of anatomical tissues and organs*. The *visible man project* has morphed into the [Virtual Family](http://www.fda.gov/AboutFDA/CentersOffices/OfficeofMedicalProductsandTobacco/CDRH/CDRHOffices/ucm302074.htm)⁴³ and is in current use

⁴³<http://www.fda.gov/AboutFDA/CentersOffices/OfficeofMedicalProductsandTobacco/CDRH/CDRHOffices/ucm302074.htm> (accessed 5 Nov. 2013).

by the Food and Drug Administration (FDA), and much of its development has been paid for by U.S. taxpayers.

“One of the advantages of using computational modeling is its ability to model the complex heterogeneous structures of anatomical tissues and to simulate the field scattering that occurs within tissues. The handset and the head or other tissue are digitized and represented by the respective properties, permittivity, and conductivity [page 17].”⁴⁴

“Special FDTD techniques have been concurrently developed to provide accurate and efficient method for modeling handsets and antennas. It has been recently shown by researchers that the exact dimensions of an antenna and its location on the handset must be precisely modeled in order to obtain accurate results. Since the inner electronics of a handset are typically not modeled, it may be necessary to verify such handset models with antenna gain or field pattern data that are generally available during product development [p. 18].”⁴⁵

“The sinusoidal or pulsed signal used to excite the antenna of a handset typically consists of an arbitrary amplitude. The results should be normalized to the appropriate output power of the actual device. It is recommended that the results should be normalized to the maximum output power measured by the manufacturers using methods similar to those described in the measurement sections of this supplement. When technical data is requested the list of items given in Appendix B may be used for guidance as to the type of information that is appropriate for demonstrating compliance [p. 18].”

All of the above information is provided for applicants who want the FCC to certify that their product is in compliance. From above, the purpose of Supplement C states, “The information in the supplement provides additional guidance for use by applicants for FCC equipment authorization in evaluating mobile and portable devices for compliance with the FCC’s guidelines for human exposure to radiofrequency (RF) electromagnetic fields.”

Bulletin 65 published four months earlier than Supplement C used language very similar to Supplement C:

⁴⁴ Permittivity and conductivity parameters, different for different tissues and by age, determine the amount of cellphone microwave radiation that will be absorbed by a specific tissue given the person’s age.

⁴⁵ My nearly 4 decade of experience in high-tech electronics confirms this statement, that the total modeling including all electronic components is available.

“With respect to evaluating portable devices, various publications are available that describe appropriate measurement techniques and methods for determining SAR for compliance purposes. The use of appropriate numerical and computational techniques, such as FDTD analysis, may be acceptable for demonstrating compliance with SAR values. Studies have indicated that such techniques can be used to determine energy absorption characteristics in exposed [p. 42].”

Bulletin 65 and Supplement C never refers to the SAM method cited extensively in the CTIA Comments, but it is mentioned indirectly as it expressed concerns about the SAM method.

1. “The permittivity and conductivity of simulated liquid tissues⁴⁶ prepared for SAR evaluation must be measured to ensure that they are appropriately for the operating frequencies of the device. These parameters are usually measured periodically or before each SAR evaluation to determine if it is necessary to add appropriate amounts of water⁴⁷ to restore the original dielectric properties as a result of evaporation [p. 12].”
2. “Most test facilities use separate head models for testing handsets on the left and right side of the head. While some models included ears and others do not, a few have also used a spacer to represent the ear [p. 12].”⁴⁸

Given the above information, it is not a surprise that the CTIA Comments cites the SAM method 19 times! Many of these citations urge the Commission to embrace SAM as a “safe harbor” for compliance. What the “safe harbor” is and who it is for, is not explained. For additional details see discussion of **FCC’s Two Certification Processes** below.

ICNIRP 1998

Shortly after the FCC adopted the IEEE 1991 standard’s exposure limits in late 1996, the International Commission on Non-Ionizing Radiation Protection

⁴⁶ A single liquid is used to simulate the absorption of all adult tissues (the head has 40 tissues). Children’s tissues are typically more absorbent than adult tissues. For additional information see **FCC’s Two Certification Processes** below.

⁴⁷ Obviously this is important but is the liquid’s dielectric properties at the time of the certification process required as part of the overall certification process?

⁴⁸ When this was written certification values would vary from one facility to the next.

published its exposure limits, which were dramatically higher than what the FCC adopted.

The CTIA Comments ask the FCC to “harmonize” its exposure limits to ICNIRP’s 2W/kg, averaged over 10 grams exposure limit. There are 23 instances where the CTIA Comments refers to ICNIRP—usually in the context of harmonizing, and also with language that states there is no danger in moving to the ICNIRP limits. For example on page 15, “The available science indicates that the IEEE and ICNIRP standard adopted in Europe and elsewhere presents no known danger to human health and might have certain public interest benefits when compared with the more restrictive standard in the United States.” As will be seen, this CTIA statement is not true.

ICNIRP is a non-governmental organization, accountable to no government, to no medical or public health body. It was founded by Michael Repacholi who served as its first chair. Its financial sources are not transparent, but there is evidence of industry funding through the Royal Adelaide Hospital where Repacholi was previously employed.⁴⁹ ICNIRP is a self-perpetuating organization, that is, existing Commissions choose new Commissioners. For additional information on Repacholi see **Credibility of Sources**, Individuals below.

Interestingly, ICNIRP also established two exposure limits, one for the general public and one for electrical workers, but with a fundamental difference. Rather than averaging the peak exposure over 1 gram of tissue, ICNIRP averages it over 10 grams of tissue. This results in a 2.3 - 3-fold increase in the allowed absorption of microwave radiation.⁵⁰ The importance of the amount of tissue used to determine SAR is discussed in the section **FCC’s Two Cellphone Certification Processes**, The Averaged Tissue Volume Is a Major Factor in Determination of SAR below.

ICNIRP’s exposure limits are:

Occupational exposure: $SAR_{WB}=0.4$ W/kg, spatial peak SAR (head and trunk)=10 W/kg; Localized spatial peak SAR (limbs)=20 W/kg, averaged over 10 grams of tissue for 6 minutes.

⁴⁹ Microwave News, Nov. 17, 2006 <http://microwavenews.com/docs/MWN.11%289%29-06.pdf> (accessed 16 Oct. 2013).

⁵⁰ Gandhi, O. P., Kang, G. (2002). Some present problems and a proposed experimental phantom for SAR compliance testing of cellular telephones at 835 and 1900 MHz. Phys. Med. Biol. 47:1501–1508.

General public exposure: $SAR_{WB}=0.08$ W/kg, spatial peak SAR (head and trunk) =2 W/kg; Localized spatial peak SAR (limbs)=4 W/kg, averaged over 10 grams of tissue for 6 minutes.

The ICNIRP standard listed more concerns than any previous standard:

Concerns

1. SAR values depend on “the frequency, intensity, polarization, and source– object configuration (near- or far-field)” and on characteristic of the body, “its size and internal and external geometry, and the dielectric properties of the various tissues [p. 497].”
2. “Several studies with rodents and monkeys have also demonstrated a behavioral component of thermoregulatory responses. Decreased task performance by rats and monkeys has been observed at SAR values in the range 1–3 W/kg (Stern et al. 1979; Adair and Adams 1980; de Lorge and Ezell 1980; D’Andrea et al. 1986) [p 505].”
3. “Reports suggest that exposure of rodents to microwave fields at SAR levels of the order of 1 W/kg may produce strand breaks in the DNA of testis and brain tissues (Sarkar et al. 1994; Lai and Singh 1995, 1996) [p. 505].”
4. “Repacholi⁵¹ et al. (1997) have reported that exposure of 100 female, Em-pim1 transgenic mice to 900-MHz fields, pulsed at 217 Hz with pulse widths of 0.6 ms for up to 18 mo, produced a doubling in lymphoma incidence compared with 101 controls. Because the mice were free to roam in their cages, the variation in SAR was wide (0.01– 4.2 W/kg) [p. 506].”
5. “[T]wo independent laboratories ... produced a small, but statistically significant, release of Ca^{++} from the surfaces of chick brain cells (Bawin et al. 1975; Blackman et al. 1979) [p. 506].”
6. “[E]ffects of AM fields on Ca^{++} binding to cell surfaces have been observed with neuroblastoma cells, pancreatic cells, cardiac tissue, and cat brain cells, but not with cultured rat nerve cells, chick skeletal muscle, or rat brain cells (Postow and Swicord 1996). Amplitude-modulated fields have also been reported to alter brain electrical activity (Bawin et al. 1974), inhibit T-lymphocyte cytotoxic activity (Lyle et al. 1983), decrease the activities of non-cyclic-AMP dependent kinase in lymphocytes (Byus et al. 1984), and cause a transient increase in the

⁵¹ “Repacholi” is Michael Repacholi, the founder of ICNIRP and its first chairman, and the founder and first leader of the International EMF Project.

- cytoplasmic activity of ornithine decarboxylase, an essential enzyme for cell proliferation (Byus et al. 1988; Litovitz et al. 1992) [p. 506].”
7. “Of particular relevance to the potential carcinogenic effects of pulsed fields is the observation by Balcer-Kubiczek and Harrison(1991) that neoplastic transformation was accelerated in C3H/10T1/2 cells exposed to 2,450-MHz microwaves that were pulse-modulated at 120 Hz [p. 504].”

The above selected list of concerns expressed in ICNIRP 1998 is followed by a disclaimer beginning with “However, ...,” which then explains why these concern are wrong. Yet these authors have little or no knowledge of these fields because they are completely outside of their primary knowledge realm: engineering expertise. Also it is important to note that “absence of evidence is not evidence of absence.”

The CTIA Comments fail to mention any of these concerns about acceleration of abnormal cell growth and other biological impacts and contends throughout there is no evidence. For example, “without any scientific evidence that the current rules pose any danger to human health, there is no need for additional regulation in the area of consumer ‘disclosures’ or encouraging consumers to limit their exposure to RF emissions [p. 15].” As we have seen and will continue to see below, there is copious scientific evidence of dangers to human health, contrary to the CTIA multitudinous assertions.

IEEE 2005⁵²

Follows ICNIRP 1998

The exposure limit changes from IEEE 1991, thus from the FCC’s exposure limits as well, are:

Occupational exposure: $SAR_{WB}=0.4$ W/kg, spatial peak SAR (head and trunk)=10 W/kg; Localized spatial peak SAR (limbs and pinnae⁵³)=20 W/kg, averaged over 10 grams of tissue for 6 minutes.

General public exposure: $SAR_{WB}=0.08$ W/kg, spatial peak SAR (head and trunk)=2 W/kg; Localized spatial peak SAR (limbs)=4 W/kg, averaged over 10 grams of tissue for 30 minutes (6 minutes for ICNIRP 1998).

Except for the longer averaging time difference for the general public, these limits are identical to ICNIRP’s limits.

⁵² CTIA refers to it variously as IEEE 2006 and IEEE 2005. IEEE 2005 is correct.

⁵³ Pinnae refers to what is commonly called “the ear” located on either side of the head

Industry and Military Participation

The number of industry and military members of the Subcommittee which created IEEE 2005 increased dramatically in comparison to IEEE 1991. For details see **Credibility of Sources**, Individuals section below.

Subcommittee Chair:

Chung-Kwang (C-K) Chou, a senior executive at Motorola's Florida Research Labs

Other Motorola Employees:

Quirino (Q) Balzano, Joe Elder, Joseph Morrissey and Mays Swicord.

Military Employees:

Eleanor Adair, Martin Meltz, Michael Murphy and Patrick Mason.

Industry consultants:

Ronald Peterson (Co-chair), Vitas Anderson, Tadeusz Babiji, William Bailey, David Black, Philip Chadwick, Linda Erdreich, Kenneth Foster, Arthur Guy, James Hatfield, Shiela Johnston, Niels Kuster, John Osepchuk, J. Patrick Reilley, Asher Sheppard, Richard Tell and Eric van Rongen

The IEEE 2005 Subcommittee had no one with medical expertise and/or public health expertise. It was a technical body, overwhelmingly representative of members who have an inherent conflict of interest. The IEEE 2005 document is a virtual clone of the ICNIRP 1998 document.

IEEE 2005 listed more than a dozen concerns:

Concerns:

1. "Studies of Latvian children living in proximity to a radar station reported a decrease in acoustical and visual reaction, neuromuscular function, memory, and attention (Lacal [R1032]) [p. 64]."
2. "Disruption of sleep has been reported in subjects exposed to RF energy either occupationally (Bielski [R267]) or living in the vicinity of RF broadcasting towers (Santini et al. [R859], [R989]), (Altpeter et al. [R977]). [p. 65]."
3. "Seven studies of correlations between headache and RF exposure derived data from subjects through questionnaires. Headache incidence and proximity to RF broadcast towers or use of mobile phones yielded a positive correlation (Hocking [R693]) (Ofstedal et al. [R755]) (Sandstrom et al. [R777]) (Chia et al. [R849], [R919]) (Santini et al. [R859], [R989]). [p. 65]."

4. “The only report of a tumor increase due to long-term RF exposure at low levels was by Chou et al.⁵⁴ [R138]. A slight increase in overall tumor incidence was reported in rats exposed for 2 years to 2450 MHz at low SAR levels (0.15-0.4 W/kg). A possible increase in pheochromocytoma (based upon only 7 tumors in exposed vs. 1 in sham exposed animals) was observed. The authors did not interpret these observations as biologically significant ... [p. 67].”

Unstated but also true, the Chou et al. study found serious adverse effects to the immune system. Table 2 reported the “number of neoplastic lesions per organ system” (35 organs), non-malignant, malignant, or metastatic, among exposed and unexposed (sham) animals. Exposed animals had double the metastatic tumors compared to unexposed (36 vs. 18; 3.6-fold more malignant tumors (18 vs. 5), and 17% more non-malignant tumor (62 vs. 55). The total number of tumors in exposed animals was 116 compared to 76 unexposed animals (>50% more tumors in the exposed animals).

C-K Chou, the chairman of the IEEE 2005 subcommittee that created this standard, was the lead author of the study and as such was responsible for the statement, “The authors did not interpret these observations as biologically significant ...”!

5. “A study by Repacholi⁵⁵ et al. [R606] using transgenic Pim-1 mice did report an association between long-term RF exposure and mortality from a certain subtype of lymphoma (follicular), but did not report a statistically significant increase in lymphoblastoid lymphomas. The Pim-1 transgenic model was specifically reported to use appearance of the latter type of lymphoma to reveal carcinogens in a shorter time frame than used for the detection of the follicular lymphomas. A subsequent study, performed at multiple exposure levels with a more uniform and better characterized exposure field, was not able to confirm the initial Pim-1 findings (Utteridge et al. [R846]) [p 67-68].”
6. “An association ... from a certain subtype of lymphoma” was a 2.4-fold statistically significant risk. “A subsequent study, performed at multiple exposure levels with a more uniform and better characterized exposure field, was not able to confirm the initial Pim-1 findings (Utteridge et al),” because the study was so badly done that animals continued to gain weight after they had died.

⁵⁴ The lead author of this study, C-K Chou, is the Chairman of the IEEE Subcommittee that created IEEE 2005.

⁵⁵ Repacholi is Michael Repacholi. For details see **Credibility of Sources**, Individuals, section below.

7. “Studies by Lai and Singh [R275], [R617] have reported DNA breaks in the brain cells of rats exposed at 2450 MHz [p. 69].”
8. “Independent replications, albeit with modifications of the initial procedure (Malyapa et al. [R641]) failed to confirm the finding.” The Malyapa “non-replication, replication”⁵⁶ study was funded by Motorola
9. The term micronuclei (MN) refers to fragmented pieces of a cell’s nucleus. “There are reports of the induction of MN by exposure of mammalian cells in vitro to specific frequencies and modulations (d’Ambrosio et al. [R800], Tice et al. [R815]) [p. 70].”
10. “When the newly calculated WBA [Whole Body Averaged] SAR values for **small children** are examined (Dimbylow [R1085]), it becomes apparent that when exposed at the previous MPE, WBA SAR values, depending on the frequency, **could exceed 0.08 W/kg by approximately a factor of two** [p. 92, **emphasis added**].”
11. “A topic of extensive discussion during preparation of this revision was the data for children relating to WBA SARs in the 2–3 GHz range (Dimbylow [R1085]). **These data, based on computational modeling, indicate that the [Basis Restrictions] for children may be exceeded** [p. 126, **emphasis added**].”
12. “The latter report [“Mobile phones and health 2004,” Documents of the NRPB, vol. 15, no. 5, National Radiological Protection Board, Chilton, Didcot, Oxfordshire, UK, 2004] stated that: ‘... **children might be more vulnerable to any effects arising from the use of mobile phones because of their developing nervous system, the greater absorption of energy in the tissues of the head, and a longer lifetime of exposure.**’ [p. 135, **emphasis added**].”
13. “The IEGMP⁵⁷ [Independent Expert Group on Mobile Phones], however, in making its risk assessment regarding the use of mobile phones by children, did not demonstrate that it gave appropriate weight to this relevant literature on the biological effects [birth defects from animal exposures during gestation, CNS structure and function including cognition, brain cancer] of RF exposure on developing laboratory animals, particularly those studies that tested mobile phone signals.”

For more information see IEGMP in the **Credibility of Sources, Organizations** section below.

⁵⁶ The term “non-replication, replication” study is used because Malyapa did not use the identical protocol that Lai and Singh used, thus it was not a replication. This is a standard technique used by industry for “replication” studies.

⁵⁷ IEGMP members included: Michael Repacholi, Anthony Swerdlow (see Credibility of Sources below).

The above selected list of concerns expressed in IEEE 2005 is typically followed by a disclaimer beginning with “However, ...” and then explains why these concerns are wrong. Yet these authors have little or no knowledge of these fields because they are completely outside their knowledge realm: engineering expertise. Also it is important to note, that “absence of evidence is not evidence of absence.”

Interestingly, the CTIA Comments never cites studies discussed in these various exposure standards whether the studies did, or did not report, adverse biological effects.

IARC’s Possible Carcinogen Finding

One section of the CTIA Comments (pages 23-26) is titled, “2. The IARC Monograph Confirms and Does Not Change the State of the Science.” As will be seen, the IARC Monograph, without doubt, changed the state of the science.

In May 2011, IARC declared that exposure to radio frequency radiation (RFR)⁵⁸ is a “Class 2B possible carcinogen.” Since RFR had not previously been declared a possible carcinogen, this was a major change to the state of the science. A study published after the IARC declaration, citing additional studies, concluded that cellphone and other wireless device radiation is a human carcinogen.⁵⁹

CTIA’s distortion of IARC’s finding

The CTIA Comments attempt to minimize this declaration when they state “The 2B category itself includes 285 agents, including RF fields alongside other ‘possibly carcinogenic’ agents like coffee and pickled [sic] vegetables [p. 25].”

By selecting coffee and pickled vegetables out of 285 agents that IARC has classified as possible human carcinogens, the CTIA is attempting to mock the classification altogether.

“Pickled vegetables” implies all pickled vegetables. There is only one pickling agent, polysulfate sodium, which led to this categorization and it is available in traditional areas of Asia. IARC Monograph 56 which made this categorization stated,

⁵⁸ Microwaves, a frequency range used by wireless devices, are within the frequency range of RFR.

⁵⁹ Davis DL, Kesari S, Soskolne CL, Miller AB, Stein Y. Swedish review strengthens grounds for concluding that radiation from cellular and cordless phones is a probable human carcinogen. *Pathophysiology*. 2013 Apr;20(2):123-9. doi: 10.1016/j.pathophys.2013.03.001. Epub 2013 May 7.

“A large case-control study of oesophageal cancer in Hong Kong showed a significant dose-response relationship between consumption of pickled vegetables and oesophageal cancer, after potential confounding factors were taken into account [p. 4].” “In a single study, extracts of pickled vegetables from northern China induced morphological transformation of Syrian hamster embryo cells in culture. Extracts of pickled vegetables from northern China and Japan are mutagenic to bacteria [p. 5].”

CTIA’s dismissal of IARC’s process for determination of Class 2B possible carcinogens

However, choosing 2 out of 285 agents to raise questions about the entire process that IARC uses in evaluating cancer hazards is merely a diversion. The question that the FCC must address in this context of the 285 agents is: What policies have governments taken with respect to these agents generally? Lead, engine exhaust, DDT, and other pesticides that are on the IARC Class 2B possible carcinogen list, are all subject to restrictions and controls by governments around the world. The question for the FCC to ask in this context is: Why should exposure to an agent identified as a cancer risk to humans be increased by up to a 3-fold? In calling for “harmonization” to the ICNIRP 1998 exposure limits, the CTIA is basically discrediting and dismissing IARC’s evaluation altogether. For details see **ICNIRP “Harmonization”** below.

Below is a partial list of well-known agents. These possible carcinogenic agents include:

Bitumens, Carbon black, Carbon tetrachloride, Chlordane, Chlordecone (Kepone), Chloroform, Coffee (urinary bladder), DDT, Diesel fuel, Engine exhaust (gasoline), Gasoline, Heptachlor, Hexachlorobenzene, Lead, Magenta, Magnetic fields (extremely low-frequency), Nickel, Nitrobenzene, Pickled vegetables (traditional in Asia), Phenobarbital, Tetrafluoroethylene, Vinyl acetate, and Welding fumes. For the complete list see **Appendix, Possible Carcinogens**.

ICNIRP “Harmonization”

There are 32 instances in the CTIA Comments that refer to ICNIRP and 16 instances referring to harmonizing exposure standards to ICNIRP. As we have seen IEEE 2005 is a virtual clone of the ICNIRP 1998 standard.

Over and over again the CTIA Comments assert the need to “harmonize” the standards.

“Indeed, as the Government Accountability Office (“GAO”) recently explained in its review of the latest research, the consensus view is that those standards are overly protective and should be harmonized with more recent international standards. [p. 1].” *The GAO report made no such statement.* It did note “Both [ICNIRP and IEEE] of these recommendations call for an exposure limit of 2.0 watts per kilogram averaged over 10 grams of tissue, which according to IEEE represents a scientific consensus on RF energy exposure limits [p. 17].”

As has been shown above and below, both ICNIRP and IEEE have fundamental conflicts of interests by calling for higher exposures to microwave radiation.

“IEEE’s new recommended limit brought it into harmony with ICNIRP’s 1998 recommendations, which have been adopted by more than 115 countries and territories in the European Union and elsewhere [p. 30].” The cited footnote (141) references a poster presented at the [BIOEM2013 meeting](#)⁶⁰ by J. Rowley, Director for Research and Sustainability at the GSM Association (an industry organization similar to the CTIA).⁶¹ *The poster did not list more than 110 countries.* CTIA Comments’ footnote 141 lists 16 countries.

Up to 3-Fold Increase in Exposure Limits

As early as 2002 a study reported, “A mobile phone compliant with the ICNIRP standard of 2.0 W/kg SAR in 10 g of tissue may lead to a 2.5 to 3 times excess above the FCC standard of 1.6 W/kg in 1 g of tissue.”⁶² Two years later, a study found, “ICNIRP guidelines and the newly proposed IEEE guidelines with a relaxed limit of 4.0 W/kg for any 10-g of tissue of the pinna⁶³ for maximum allowable powers for cellular telephones at 835 and 1900 MHz to show that the newly proposed relaxed IEEE limits will allow radiated powers that may be 8–16 times those permitted by the current IEEE Standard and up to two times higher than those permitted under ICNIRP guidelines used in over 30 countries.”⁶⁴ Another paper stated, “The results suggest that the recommended ICNIRP reference levels need to be revised.”⁶⁵

⁶⁰ <https://www.bems.org/node/6340> (accessed 15 Nov. 2013).

⁶¹ <https://www.bems.org/node/6340> (accessed 6 Nov. 2013).

⁶² Gandhi, O. P., Kang, G. (2002). Some present problems and a proposed experimental phantom for SAR compliance testing of cellular telephones at 835 and 1900 MHz. *Phys. Med. Biol.* 47:1501–1508.

⁶³ The pinna’s common name is the ear.

⁶⁴ Gandhi, O. P., Kang, G. (2002). Inaccuracies of a Plastic “Pinna” SAM for SAR Testing of Cellular Telephones Against IEEE and ICNIRP Safety Guidelines. *IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES*, VOL. 52, NO. 8, AUGUST 2004.

⁶⁵ Bakker, J. F., Paulides, M. M., Christ, A., et al. (2010). Assessment of induced SAR in children exposed to electromagnetic plane waves between 10MHz and 5.6 GHz. *Phys. Med. Biol* 55(11):3115–3130.

Exposure Limit Change for Children and Fetuses

Contrary to the CTIA assertion, the *method used to certify that wireless devices meet the exposure limits should be changed* such that children's and fetuses' exposures are included along with the most vulnerable tissues (e.g., female breasts, testes, eyes, brain, parotid and thyroid glands.). The currently used certification process is not realistic and does not reflect the use of metal frame eye glasses, wearing of metal jewelry, dental braces and metal piercings. The GAO Report (published 7 Aug. 2012) on its opening page, captioned “**What GAO Recommends,**” stated, “FCC should formally reassess and, if appropriate, change its current RF energy exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body. FCC noted that a draft document currently under consideration by FCC has the potential to address GAO's recommendations.” Fifteen months later, the draft document has yet to be released, and the problem of “phones held against the body” has yet to be addressed.

The certification process should include consideration of interaction of microwave radiation with commonly worn metal by persons (e.g., metal frame eye glasses, ear rings, metal necklaces, wire supported bras, body-piercing studs, orthodontic teeth braces, etc.) along with any metal (decorations or otherwise) placed on cellphones' cases. For details see **FCC's Two Certification Processes**, What the Science Has Found Since the Adoption of the FCC Limits in 1996, Studies Showing Children's Exposure Is Higher than Adults and Comparison of the SAM and FDTD Computer Simulation Processes below.

Fifty-fold Safety Limit Is Specious

The CITA Comments refers 18 times to a specious claim that there is a 50-fold safety factor to the current FCC exposure limits.⁶⁶

CTIA's specious logic is there was a 10-fold safety factor established based on “reliable evidence of hazardous effects [hungry rats stop ceased searching for food] is associated with whole body-averaged SARs above 4 W /kg.” Yet, “The assumption is that reversible disruption during an acute exposure is tantamount to irreversible injury during chronic exposure.” This 10-fold “safety” factor was

⁶⁶ Pages 12 (twice), 28, 34, 34 (footnote 163), 40, 40 (footnote 183-twice), 40 (footnote 185), 43, 47, 49 (footnote 226), 56, 56 (footnote 252), 56 (footnote 253), 57, 57 (footnote 256), and 59.

increased by another factor of 5 for the general public. Thus, CTIA's logic claims there was a 50-fold safety factor.

Five-fold factor for general public is non-existent

As noted above, the alleged 5-fold safety factor between the general public and electrical workers *does not exist*. IEEE 1991 reduced the dose-rate (SAR) for the general public by a factor of 5 relative to electrical workers but increased the average exposure time by a factor of 5 (from 6 minutes to 30 minutes) relative to electrical workers. Put simply, for the general public the dose-rate was reduced 5-fold and the total dose allowed was increased 5-fold, resulting in **identical** doses for workers and the general public.

Ten-fold factor is a 2.5-fold factor from irreversible damage

The CTIA's alleged factor of 10, which can cause "irreversible injury," was based on a 4 W/kg whole-body exposure which caused hungry rats to cease searching for food. But seven years earlier, another study, known to the ANSI 1982 authors, found that hungry rats ceased searching for food when exposed to a whole-body radiation of 1 W/kg.⁶⁷ Thus, at most there is a 2.5-fold safety factor from what the authors stated was "tantamount to an irreversible" injury.

In public health policy, safety factors for food or drinking water contaminants are customarily set at 100-fold or more.⁶⁷

FCC's Two Cellphone Certification Processes

As noted above (see FCC Bulletin 65 1996 and its Supplement C 1997 section) the FCC has approved, in contradiction of the CTIA Comments⁶⁸, two cellphone certification processes:

SAM Process

Using a large plastic head, called the Specific Anthropomorphic Mannequin (SAM), a liquid is poured inside that is alleged to have the radiation absorption properties of the 40 tissue types in the average adult human head. With a cellphone attached alternately to the right and left side of SAM where the ear⁶⁹ would be, a robotic arm with an electric field probed is manipulated inside the head as the probe measures the strength of the electric field. Using the electric

⁶⁷ <http://www.foodsafetymagazine.com/magazine-archive1/december-2010/january-2011/understanding-and-managing-food-safety-risks/> (accessed 15 Nov. 2013).

⁶⁸ "Since 2002, the Commission's sole pre-approved method for testing has been through the IEEE-recommended specific anthropomorphic mannequin (SAM) [p. 6]."

⁶⁹ It is not a plastic ear shaped like a real ear, but a plastic spacer.

field values the SAR is calculated at 3-dimensional coordinates and the maximum SAR value is reported to the FCC as *part* of the cellphone certification process.



SAM Phantom

Source: SPEAG Phantom Product Flyer



Robotic arm with electric field probe

Source: SPEAG DASY 52 Info Sheet

Organized by C-K Chou, and designed by industry, the SAM Process (commercially available from a single source) has been exclusively used to certify that cellphones meet the exposure limits.

Computer Simulation Process

Using a computer algorithm, finite-difference time-domain (FDTD), and the radiation absorption properties of individual tissues, along with the laws of physics that describes how radiation will bend as it penetrates through the 40 tissues types in the head, the computer calculates the SAR for any defined volume (or weight) of tissue.

As noted above, the FCC described FDTD computation as, “the most widely accepted computational method for SAR modeling. This method adopts very well to the tissue models which are usually derived from MRI or CT scans, such as those available from the visible man project. FDTD offers great flexibility in modeling the inhomogeneous structures of anatomical tissues and organs.”

Details of SAM Cellphone Certification Process

Measurement accuracy: $\pm 30\%$

Measurements made with the SAM process are accurate to $\pm 30\%$ of the measured value.

“With *proper preparation and execution* of a SAR measurement according to the protocols in this recommended practice, the target expanded measurement uncertainty for all uncertainty components in Table 5 and Table 6 *should be* less than $\pm 30\%$ (+1.14 dB, -1.55 dB) for peak spatial-average SAR values in the range from 0.4–10 W/kg. *If uncertainty is higher*, the test lab should evaluate which measurement uncertainty component(s) need to be reduced to achieve the $\pm 30\%$ target uncertainty, and then take actions to implement improvements. When the expanded uncertainty is greater than 30%, the measured results may need to take into account the percentage difference between the actual uncertainty and the 30% target value [emphasis indicates *conditional language*].”⁷⁰ Table 5 has 5 parameters (4 are for the liquid’s absorption parameters) which contribute to the “Combined standard uncertainty.” Table 6 has 13 parameters that contribute to the “Combined standard uncertainty. Each of the parameters in both Tables has 5 contributing factors.

Because the SAM Process has a $\pm 30\%$ measurement accuracy, no value above 1.12 W/kg (30% lower than the limit) should be accepted to insure that the 1.6 W/kg averaged over 1 gram of tissue exposure limit is not violated.

Sole-source Supplier

The system required to implement the SAM Process comes from a *sole-source* manufacturer, SPEAG (Schmid & Partner Engineering AG). SPEAG manufactures or supplies almost of the equipment required by the SAM Process:

- Systems
- Robot arm
- Robot Controller
- Robot Accessories
- Mounting devices and adaptors
- Fifteen various probes
- Three versions of SAM (flat phantoms)
- Four Flat Phantoms (used to measure SAR to body)

⁷⁰ IEEE Std 1528™-2003, p. 55-56.

Three Special Phantoms
Membrane Phantom
Flat Phantom
Modular Flat Phantom

Niels Kuster is Co-founder and President of the Board of Directors of SPEAG, and is the founding Director of the Foundation for Research on Information Technologies in Society (IT'IS), Switzerland, a Subcommittee member of the IEEE-2005 standard, a Member of the UK Mobile Telecommunications and Health Research (MTHR) organization, and held an invited professorship at the Electromagnetics Laboratory of Motorola, Inc., Florida.

The CTIA Comments cite “SAM” 29 times.⁷¹ Five of these “SAM” citations refer to the SAM Process as a “safe harbor,” although what is a “safe harbor,” and who or what it harbors, is unexplained.

The multiple levels of financial conflicts of interest associated with the SAM Process, the extraordinarily large $\pm 30\%$ accuracy of SAR measurements, combined with the FCC’s own language that the alternate process is

“the most widely accepted computational method for SAR modeling. This method adopts very well to the tissue models which are usually derived from MRI or CT scans, such as those available from the visible man project. FDTD offers great flexibility in modeling the inhomogeneous structures of anatomical tissues and organs,”

implies it is nonsense to continue using the SAM Process to certify that cellphones meet the exposure limits.

Details of FDTD Computer Simulation Cellphone Certification Process

The Food and Drug Administration (FDA) is currently using this process in its Center for Devices and Radiological Health (CDRH), but only to evaluate and approve medical devices internal to the body. The FDA is a co-developer of the “[Virtual Family](#)” with the Swiss IT'IS Foundation⁷². The Virtual Family includes 6 models of children from 5-14 years of age and pregnant women 3, 6

⁷¹ Pages: i (twice), 6, 6 (footnote 26), 16 (3-times), 28, 29 (4-times), 29 (footnote 136), 40 (footnote 186-twice), 52 (4-times), 53 (8-times), 53 (footnote 241), and 54.

⁷² <http://www.itis.ethz.ch/services/anatomical-models/overview/> (accessed 6 Nov. 2013).

and 9 months gestation.⁷³ Additional Virtual Family members are in development.

The Virtual Family models come from MRI scans and are based on the resultant human anatomy for each family member. The FDTD simulation incorporates frequency dependent and *age dependent* (typically children's tissues are more absorbent than adults') microwave absorption properties for various tissues.

Tissues' absorption properties vary widely with particular tissues and with age. Children's tissues are typically more absorbent than adults', and younger children's are more absorbent than older children's. See What the science has found since the adoption of the FCC limits in 1996, *Studies Show Children's Exposure Is Higher than Adults'* section below.

Yet the CTIA Comments states,

1. In regards "to whether existing ... standard are ... protective of children. The scientific consensus supports the Commission's existing ... standards ... No change in the state of the science warrants reconsidering them [p. 26]."
2. "The Commission's 1996 ... federal safety standards ... on the limits ... determined that its ... limits ... protect all members of the public, including children. Research into this area has continued and has confirmed that existing standards are safe for children. [p. 27]."
3. "The conservative nature of the Commission's current emission standards and testing regime ensures that children are appropriately protected. The emission standard's fifty-fold safety factor 'accommodates a variety of variables such as different physical characteristics,' thereby accounting for adults and children alike. [p. 28]."
4. "[T]here are no science-based reasons to tighten either the emission standards for, or the testing methodology associated with, children [p.29]."

What the science has found since the adoption of the FCC limits in 1996

Studies Show Children's Exposure Is Higher than Adults'

1. A 2001 paper reported children's SAR is 50–100% higher than an adult's SAR. "The results show a general decrease of the dielectric properties [the lower the dielectric properties the higher the absorption of microwave radiation] with age. The trend is more apparent for brain, skull and skin

⁷³ The Virtual Family. IT'IS Foundation and FDA, p. 2.

(<http://www.itis.ethz.ch/assets/Downloads/VirtualPopulation/1302-virtual-population.pdf>, accessed 23 Oct. 2013).

tissues and less noticeable for abdominal tissues. The variation in the dielectric properties with age is due to the changes in the water content and the organic composition of tissues.”⁷⁴

2. A 2004 paper found as the head size decreases, the percentage of energy absorbed in the brain increases; so higher SAR in children’s brains can be expected.⁷⁵
3. A 2002 study reported that SAR will be up to 7-times higher when the back of cellphone (where the antenna is located) is placed in a shirt pocket next to the skin.⁷⁶ This 2002 study easily explains why a 2013 case study reported multiple primary breast cancer in women who keep cellphones in their bras.⁷⁷
4. A 2006 study found “that under similar conditions, the 1g-SAR calculated for the children is higher than that for the adults. When using the 10 years old child model, SAR values higher than 60% than those for adults were obtained.”
5. A 2009 Report states “bone marrow exposure strongly varies with age and is significantly larger for children (~10x).” The author was Niels Kuster, the founder of SPEAG, the sole-source supplier of equipment required by the SAM cellphone certification process. Hippocampus and hypothalamus receive 1.6–3.1 higher SAR in children compared to adults’; children’s bone marrow receive 10 times higher SAR than adults’; children receive higher SAR to the eyes than adults; children’s cerebellum absorbs >2.5 times higher SAR than adults. Exposure to the eyes is higher in children than in adults.⁷⁸
6. A 2008 paper by authors who were employed by France Telecom and TELECOM ParisTech found, “The comparisons have also shown that the maximum SAR in 1 g of peripheral brain tissues of child models aged between 8 and 15 is comparable to the maximum SAR in 1 g of peripheral brain tissues of adult models while it is about two times higher for child models aged between 5 and 8. This is certainly due to the smaller

⁷⁴ Peyman A, Rezazadeh AA, Gabriel C. Changes in the dielectric properties of rat tissue as a function of age at microwave frequencies. *Phys. Med. Biol.* 46 (2001) 1617–1629.

⁷⁵ Martinez-Burdalo, M., Martin, A., Anguiano, M., et al. (2004). Comparison of FDTD-calculated specific absorption rate in adults and children when using a mobile phone at 900 and 1800 MHz. *Phys. Med. Biol.* 49(2):345–354.

⁷⁶ Gandhi, O. P., Kang, G. (2002). Some present problems and a proposed experimental phantom for SAR compliance testing of cellular telephones at 835 and 1900 MHz. *Phys. Med. Biol.* 47:1501–1508.

⁷⁷ West JG, Kapoor NS, Liao S-Y, Chen JW, Bailey L, Nagourney RA. Case Report Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones. *Case Reports in Medicine* Volume 2013, Article ID 354682. <http://dx.doi.org/10.1155/2013/354682>

⁷⁸ Christ, A., Gosselin, M-C, Christopoulou, M., et al. (2010). Age-dependent tissue-specific exposure of cell phone users. *Phys. Med. Biol.* 55:1767–1783.

thicknesses of pinna, skin and skull.”⁷⁹ These results were based on “the same dielectric properties as the ones used for the adult models.” Their “analysis confirms that the peripheral brain tissues of children seem to be higher exposed than the peripheral brain tissues of adults.”

7. In 2010 Kuster et al. found averaged over 10 grams of tissue (it will be significantly larger averaged over 1 gram of tissue)⁸⁰:

The above 7 studies is a partial listing of studies since the 1996 FCC exposure limits were adopted. The CTIA Comments ignores these studies and many others while glibly stating over and over again either that no change is necessary or the Commission should “harmonize” the standards to the much higher ICNIRP levels.

The Averaged Tissue Volume Is a Major Factor in Determination of SAR

The volume of tissue used is a very important parameter where the SAM or FDTD Computer Simulation Cellphone Certification Processes are used. It is clear that averaging the SAR over 1 gram of tissue results in a much higher SAR than averaging the SAR over 10 grams of tissue.

Using the FDTD computer simulation process the SAR values averaged over 10,000, 1,000, 100, 10 and 1 milligrams (mg) of tissue for children aged 1, 6, 8 and 10 year olds were presented at the joint annual meeting of the Bioelectromagnetics Society (BEMS) and European Bioelectromagnetics Association (EBEA) in Greece, June 2013.⁸¹ The results are shown below in Figure 1.

As is seen in Figure 1, the smaller the weight (or volume) of tissue the higher the SAR. For a 6-year-old child, the SAR is almost 9-times higher when averaged over 1 milligram (mg) of tissue compared to the ICNIRP standard of 10 grams. Compared to the FCC standard of 1 gram, averaged over 1 mg, the 6-year old child’s SAR is over 6-times higher.

⁷⁹ Wiart J, Hadjem A, Wong MF, Bloch I. Analysis of RF exposure in the head tissues of children and adults. *Phys. Med. Biol.* 53 (2008) 3681–3695.

⁸⁰ Niels Kuster et al. Age-dependent tissue-specific exposure of cell phone users. *Phys. Med. Biol.* 55 (2010) 1767–1783.

⁸¹ Fernandez et al. Preliminary SAR simulation is highest for smallest volumes, youngest age groups, and highest dielectric constant. BIOEM2013, June 2013

One milligram (mg) of brain tissue is equivalent to 1 cubic millimeter (1 mm^3) of volume. The number of nerve cells (neuron) in 1 mm^3 is about 100 million.⁸² There are many other cell types within this 1 mm^3 volume such as glial cells, which can form a cancer known as a glioma.

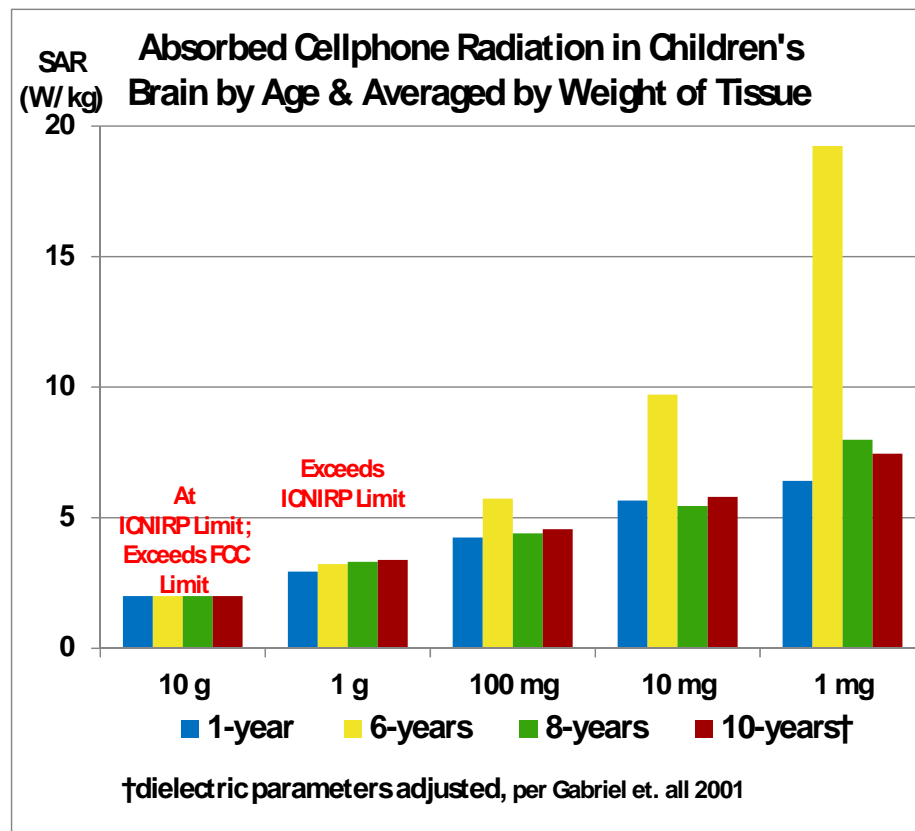


Figure 1. Specific Absorption Rates (SAR) from cellphone radiation averaged over various tissue weights for children of different ages.

Comparison of the SAM and FDTD Computer Simulation Processes

The CTIA Comments states, “One study conducted by an international task force of experts lead by Dr. Brian Beard of the FDA compared numerical computation of SAR using SAM- and MRI-based models of normal adults and found that ‘SAM produced a higher SAR in the head than the anatomically correct head models. Also the larger (adult) head produced a statistically significant higher peak SAR . . . than did the smaller (child) head for all conditions of frequency and position’ [p. 29],” but failed to mention that this *one study* was performed with the Mobile Manufacturers Forum (MMF), a European based industry organization similar to the CTIA.

⁸² http://wiki.answers.com/Q/How_many_nerve_cells_are_in_a_cubic_centimeter_of_the_human_brain (accessed 24 Oct. 2013).

An August 2011 Korean paper reports that the SAM Process is *not conservative* as is claimed in regards to children.⁸³ Using a SAR averaged over 10 grams of tissue the authors reported,

“For Phone_{PIFA}⁸⁴ exposure, in 50% and 70% of all cases considered, the SAM phantom provides an underestimation for pinna-excluded and pinna-included tissue conditions, respectively.” They also report “for Phone_{monopole}⁸⁵ exposure at 1900 MHz, the SAM phantom shows underestimations of 40% (i.e., 8 of the total 20 cases) for pinna-excluded tissue and 80% for pinna included tissue.”

When pinna tissue is compared to SAM at 835 MHz the SAR is increased by 105% and at 1900 MHz it is increased by 70%. The Conclusion section begins:

“The SAM phantom based on IEEE Std 1528 and IEC 62209-1 is a standard head model that was designed to produce a conservative average in spatial peak mass for 1- and 10-g SARs in the human heads of a majority of phone users including children.” Additionally they find that a cellphone held over the ear canal (EEC position) rather than as described in the IEEE std 1528 for the ERP position (15 mm from the top of the head), the SAR is higher when held over the ear canal as can be expected in most users. “However, the rationale for the 15-mm distance between the ERP and EEC is unclear, and is applied only to the SAM phantom.”

Table 1 compares the two FCC approved cellphone certification processes’ capabilities.⁸⁶

As can be seen, for all 12 attributes in Table 1, the FDTD computer simulation process is superior. This process is already used by the FDA.

It is not possible for the SAM process to model the effects of body worn metal devices such as eye glasses, wire frame bras, ear rings, necklaces, dental braces and the multitude of metal piercings worn by adolescents and young adults. It

⁸³ Lee & Yun. A Comparison of Specific Absorption Rates in SAM Phantom and Child Head Models at 835 and 1900 MHz. IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY, VOL. 53, NO. 3, AUGUST 2011.

⁸⁴ PIFA: “a mobile phone equipped with a planar inverted F antenna (PIFA) hidden within its housing and operating at 1900 MHz.”

⁸⁵ Monopole: a monopole antenna.

⁸⁶ Gandhi OP, Morgan LL, de Salles AA, Han Y-Y, Herberman RB, Davis DL. Exposure Limits: The underestimation of absorbed cell phone radiation, especially in children. Electromagnetic Biology and Medicine, 31(1): 34–51, 2012.

is virtually impossible for the SAM process to determine peak SAR values at resolution less than one cubic centimeter (1 cm^3), equivalent to 1 gram of tissue.

The SAM process says it can model the head and the body but must assume that the head and body have no tissue differences.

Attribute	SAM Process	FDTD Process	Comments
Children's exposure	No	Yes	Multiple ages
Pregnant women's exposure	No	Yes	1,3 & 9 months
Female exposure	No	Yes	
Specific tissue parameters	No	Yes	
3-D resolution	$\sim 1 \text{ cm}^3$	$<1 \text{ mm}^3$	
Relative cost	Higher	Lower	
Medical implant modeling	No	Yes	
Testicle exposure	No	Yes	
Female breast exposure	No	Yes	With & without wire frame bra
Eye exposure	No	Yes	With & without wire frame eyeglasses
Thyroid gland exposure	No	Yes	With & without metal necklace
Parotid gland exposure	No	Yes	

Table 1. A comparison of the capabilities of the two FCC approved cellphone certification processes.

The SAM Process cannot possibly model the exposure to the eyes, testicles, parotid glands⁸⁷, thyroid gland, and penis, all of which are substantially exposed depending on the location of the cellphone.

The CTIA Comments ignore the exposure to other tissues and ignore the interaction of metal with the incident cellphone radiation. Yet, the CTIA Comments appear to be aware of these issues when it states, "Finally, absorption also varies from person to person based on the inevitable inhomogeneity of human anatomy and tissues [p. 28]." The CTIA admits that human beings are not homogenous, but the CTIA ignores the existence of the FCC approved computer simulation process which deals with the reality that human beings are inhomogeneous.

⁸⁷ A large salivary gland located in the cheeks.

Methodology Problems with the FCC Cellphone Certification Process

This section explains major problems that exist with the FCC cellphone certification process *even if the SAM Process was perfect*. It also shows that the data sent to the FCC clearly show an iPhone 5 cellphone model violated the certification criteria, and nevertheless it was certified that it met the limit and it could to be sold to customers.

Submission of Single Cellphone Model for Certification

A single cellphone is brought to an FCC certified testing facility (Telecommunications Certification Body or TCB). The FCC requires, “The performance and operating tolerances of a test device should be fully characterized to ensure that it is identical to the production units for meeting compliance [Supplement C, p. 45],” but provides no further information how this conditional sentence should be verified, and no proof is required that “it is identical to the production units.”

There is no knowledge how this cellphone was chosen. Was it selected from a large number because its radiated power was smaller? Or was it randomly selected? Was it a prototype of the final product? Or was it from a mass-produced production line? The testing facility has no knowledge of where the single unit came from or how it was selected.

iPhone 5's SAR Data Submitted to the FCC Violated the Exposure Limit

One example of documentation sent to the FCC was the submission of Apple's iPhone 5 data to the FCC.⁸⁸

In the documentation submitted to the FCC there were 21 specific tests, found in 11 tables where the unit exceeded the 1.6 W/kg exposure limit.

1. Table 17.1.1, p. 356 has 3 SAR values >1.6 W/kg.
2. Table “Sum of the SAR with Measured Values (Secondary Antenna),” page 360 has one SAR value >1.6 W/kg.
3. Table 17.1.2, page 262 has two values >1.6 W/kg.
4. Table 17.1.3, page 266 has one value >1.6 W/kg.
5. Table 17.1.4, page 369 has two values >1.6 W/kg.
6. Table 17.1.5, page 373 has two values >1.6 W/kg.
7. Table 18.1.1, page 388 has two values >1.6 W/kg.
8. Table 18.1.2, page 392 has two values >1.6 W/kg.

⁸⁸ SAR EVALUATION REPORT, For iPhone Model: A1428, A1429, FCC ID: BCG-E2599A, Report Number: 11U14136-7A1, Issue Date: 9/6/2012

9. Table 18.1.3, page 396 has two values >1.6 W/kg.
 10. Table 18.1.4, page 400 has two values >1.6 W/kg.
 11. Table 18.1.5, page 404 has two values >1.6 W/kg.
- Every value >1.6 W/kg was easy to find as they were all in red font.

Page 355 introduces a new and bizarre *draft* rule. It reads in whole:

17. Simultaneous Transmission SAR Analysis (Model A1428)

KDB 447498 D01 General RF Exposure Guidance v05 (Draft)⁸⁹, introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

SAR_1 is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of

$$[(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2]$$

A new threshold of 0.04 is also introduced in the draft KDB. Thus, in order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri < 0.04$$

FCC has authorized the use of the draft SPLSR formula for this application.

The result of this bizarre *draft* rule, authorized by the FCC, is it exempts 20 of the 21 violations of the exposure limit. When a unit analysis of the “SAR to Peak Location Ratio” (SPLSR) value is performed, it is even more bizarre. The units are $(W/kg)^{1.5}/cm^2$,⁹⁰ a value whose units make no sense whatsoever.

The logic for this exemption is not explained in KDB 447498 D01. This exclusion rule’s sole purpose seems to be to allow violations of the exposure limit. For the iPhone 5 it excludes 20 of the 21 exposure limit violations, yet one violation of the exposure limit remains. Nevertheless the iPhone 5 was introduced for sale 6 business days later (Sept. 14, 2012) after the FCC received “Report Number: 11U14136-7A1, Issue Date: 9/6/2012” with

⁸⁹ <https://apps.fcc.gov/kdb/GetAttachment.html?id=OkBNcs41tmuCWotMVUf2tA%3D%3D> (accessed 24 Oct. 2013).

⁹⁰ Centimeter is the assumed unit, but the rule does not define the units. It could be meters (m) or millimeters (mm).

between 1 and 21 violations of the exposure limit, depending on whether the *draft* exclusion rule is considered.

Post-Market Surveillance

According to the GAO Report, “FCC requires TCBs to carry out this post-market surveillance program, through which each TCB tests one percent of the mobile phones they have certified for RF energy exposure, to ensure that the phones continue to meet FCC’s RF energy exposure limit [p. 24].”

With this post-market surveillance program the FCC has no way to monitor the millions to hundreds-of- millions of units produced annually as part of a post-market surveillance system.

It is unstated, but let’s assume the post-market surveillance is once per year (as written it could be interpreted as one time only). A Silicon Valley TCB stated it has certified “close to a thousand cellphones.”⁹¹ If the average TCB has certified 100 cellphones then they would be required to test 1 cellphone model once a year (or once given the ambiguity of the sentence). With such a post-market surveillance system it would be virtually impossible to find if one percent of a particular cellphone model has exceeded the exposure limits even if millions of units were shipped per year.

Credibility Sources

In this section, individuals’ and organizations’ credibility are examined for inherent conflicts-of-interests because of their associations with the telecommunication and electrical utility industries. Organizations are also listed if they abdicate their role to an organization with conflicts-of-interests.

Organizations

AGNIR--Advisory Group on Non-ionising Radiation

See HPA below.

Exponent Inc.

Exponent Inc. has been described in David Michael’s book *Doubt Is Their Product* as one of many “Product Protection Firms” hired to cast doubt that a product is harming workers and/or customers. Exponent is cited 11 times in the index of *Doubt Is Their Product*. Among its many employees are: Linda

⁹¹ Cetecom, Inc.

Erdreich, Senior Managing Scientist and William H. Bailey, Principal Scientist. Both are members of the IEEE 2005 Subcommittee.

HPA—Health Protection Agency

The UK's Health Protection Agency (HPA) states on their web page, "There is no explicit UK legislation that limits people's exposure to electromagnetic fields, including the radio waves used in mobile telephony," then goes on to state, "The Recommendation incorporates the restrictions on exposure of the general public advised by ICNIRP in its 1998 guidelines."⁹²

With no apparent internal expertise the HPA relies on the Advisory Group on Non-ionising Radiation (AGNIR). The CTIA Comments lauds AGNIR:

"The UK Health Protection Agency Advisory Group on Non-Ionizing Radiation concluded in a comprehensive 2012 review and evaluation of the science that, 'although a substantial amount of research has been conducted in this area, there is no convincing evidence that RF field exposure below guideline levels causes health effects in . . . children' [p. 27]."

AGNIR is not an independent group and is not part of HPA per se.

Members of AGNIR with conflicts-of-interests are:

The AGNIR Chairman is Anthony Swerdlow, and Maria Feychting is an AGNIR Member.

IEEE—Institute of Electrical and Electronic Engineers

As noted above in The History of Exposure Standards section, this organization has inherent conflicts-of-interests because its members are part of the very industry which the FCC has the duty to regulate.

Its primary role is to provide services to the electricity and electronic industries. It has little to no medical or public health expertise.

IEGMP—Independent Expert Group on Mobile Phones (see IEEE 2005 section above)

Two of its members, Michael Repacholi and Anthony Swerdlow have documented conflicts-of-interest.

ICNIRP—International Commission on Non-Ionizing Radiation Protection

⁹² Last revised 17 February 2010, accessed 29 Sept. 2011.

This organization is not accountable to any government, any public health agency, or any public health agency. Its sources of income are not transparent. It is a self-perpetuating organization whose existing Commissioners appoint new Commissioners.

The founder and first Chairman was Michael Repacholi.

Current Commissioners (*italics indicate listed in Individuals below*) are:

Rüdiger Matthes (Chairperson), *Maria Feychting* (Vice Chairperson), Rodney Croft, *Adèle Green*, Kari Jokela, James Lin, Carmela Marino, Agnette P. Peralta, Zenon Sienkiewicz, Per Söderberg, Bruce E. Stuck, Eric van Rongen, Soichi Watanabe, Gunde Ziegelberger (Scientific Secretary), and *Michael Repacholi* (Chairman Emeritus).

Two previous Commissioners were Anthony Swerdlow and Anders Allbom.

*International EMF Project*⁹³

This organization is cited 13 times by the CTIA Comments, with 2 exceptions, it is *always* identified as the World Health Organization (WHO). While the International EMF Project is embedded within WHO, there is no evidence that it receives any funding from WHO, but it does receive funding from industry via the Royal Adelaide Hospital in Australia.⁹⁴ Michael Repacholi founded the International EMF Project and previously was employed by the Royal Adelaide Hospital. This indirect funding path from industry to the Royal Adelaide Hospital and back to the International EMF Project was not acknowledged until the media confirmed it and began to ask questions.

The 13 citations for the International EMF Project in the CTIA Comments are:

1. “Cell phones are not associated with increased health risks [p. 20].”
2. “See Power Point: Shaiela Kandel, ELF Policies Worldwide – Protection of General Public, at the WHO Workshop, “Developing and Implementing Protective Measures for ELF EMF” (Jun. 20-21, 2007) [footnote 141, p. 140].”
3. “[B]ecause many manufacturers’ phones are sold in multiple countries, ‘manufacturers have to develop and test phones based on different exposure limits, which can require additional resources and slow the time it takes to get new phones into the market.’ [p. 32].”

⁹³ <http://www.who.int/peh-emf/project/en/>

⁹⁴ Microwave News, “Microwave News Responds to Mike Repacholi”, Vol. XXVI No. 9 Nov. 17,. 2006. <http://microwavenews.com/docs/MWN.11%289%29-06.pdf> (accessed 25 Oct. 2013)/

4. “Moreover, bringing Commission limits into line with those of the majority of the world would reduce unwarranted fears and ‘controversy connected with RF fields.’ [p. 32].”
5. “[T]he WHO’s International EMF Project advocates ‘harmonization of ... standards worldwide’ because it is in large part the ‘disparities in EMF standards’ themselves that have caused ‘increasing public anxiety....’ [p. 32].”
6. “What is more, harmonization would facilitate global research efforts ...[footnote 158, p. 33].”
7. “... and cooperation in the field [footnote 159, p. 33].”
8. “The International EMF Project’s model legislation and regulations recommend adoption of the currently-applicable ICNIRP standards [p. 33].”
9. “[T]here is a clear consensus in the scientific community that ‘exposures below the limits recommended in the ICNIRP international guidelines do not appear to have any known consequence on health’ [p. 33-34].”
10. “Like the current Commission standard, the ICNIRP-recommended emission standard for the general population is set at 50 times below the level at which biological impacts are observed, thus providing a significant safety margin [p. 34].”
11. “The conservative nature of the Commission’s RF regime also obviates the need for consumer advisories [p. 40].”
12. “The Commission has rejected calls to regulate based on non-thermal effects, modulation effects and ELF fields, and the science has not changed [p. 47].”
13. “As the WHO, IARC and the IEEE have found, there is a lack of credible scientific evidence establishing health risks caused by non-thermal effects, ELF fields or modulation effects [p. 50].” In this quote, WHO refers to the International EMF Project, IARC refers to Monograph 97 (2008), and IEEE refers to IEEE 2005.

Given the clear connection of the International EMF Project to industry funding, including funds to an Australian Hospital, and forwarded back to International EMF Project, these 13 citations should be seen as invalid on their face.

International Epidemiology Institute (IEI)

IEI designed the Danish Cellphone Subscriber Cohort study. “According to Bloomberg Financial News (Mobile Phones Don't Cause Brain Cancer or Leukemia, Study Finds; 2/26/02), IEI completed a study that cost \$373,000 and was funded in part by Denmark's largest phone company, Tele Danmark A/S, which is partially owned by SBC Communications, and the second-largest mobile phone service in Denmark, Sonofon A/S, owned by Telenor AS and BellSouth Corp.”⁹⁵

The Danish Cellphone Subscriber study has been strongly criticized for its methodology, not the least of which was the exclusion of 42% of its subscribers. Corporate users—arguably the heaviest cellphone user—were 28% of the subscribers.

The CTIA Comments states, “a large cohort study following cell phone users in Denmark from 2001 to 2011 has found no association between cell phone use and glioma, meningioma or acoustic neuroma [p. 21].”

In fact, the Danish Cellphone Subscriber Cohort study was recognized by the IARC Working group that produced Monograph 102 as affected by substantial misclassification, so that it was discounted in reaching the evaluation that radiofrequency fields were a possible human carcinogen, category 2B.

MTHR—Mobile Telecommunications and Health Research

MTHR is jointly funded by the UK Government and the mobile telecommunications industry.⁹⁶ Its current and former members include: Niels Kuster and Michael Repacholi.

SCENIHR—Scientific Committee on Emerging and Newly Identified Health Risks

In January 2009 SCENIR adopted an “opinion” on the “Health Effects of Exposure to EMF.” For radio frequency fields, “It is concluded from three independent lines of evidence (epidemiological, animal and in vitro studies) that exposure to RF fields is unlikely to lead to an increase in cancer in humans. However, as the widespread duration of exposure of humans to RF fields from mobile phones is shorter than the induction time of some cancers, further studies are required to identify whether considerably longer-

⁹⁵ http://www.cspinet.org/integrity/nonprofits/international_epidemiology_institute.html (accessed 28 Oct. 2013).

⁹⁶ <http://www1.itis.ethz.ch/mv/downloads/DAY3/3E-Challis-s.pdf> (accessed 6 Nov. 2013).

term (well beyond ten years) human exposure to such phones might pose some cancer risk.”⁹⁷

Among the participants who created this “opinion” were Anders Ahlbom, Joachim Schüz and Eric van Rongen. For additional information on these participants, see Individuals section below.

*SSI—Swedish Radiation Protection Authority*⁹⁸ (now SSM-Swedish Radiation Safety Authority)

In 2002, SSI hired the International Epidemiology Institute (IEI) to evaluate epidemiological studies on brain tumor risks.

FSM—Swiss Research Foundation on Mobile Communications

Among many projects, FSM funded a childhood brain cancer study called CEFALO. “The Swiss Research Foundation on Mobile Communication (FSM) is a non-profit foundation approved by the Swiss Federal Supervisory Board of Foundations. ... The FSM is sponsored by ETH Zurich, Orange, Sunrise and Swisscom.”⁹⁹ Orange, Sunrise and Swisscom are each cellphone corporations.

Individuals

Dr. Eleanor Adair (deceased)

She was a member of the IEEE 2005 Subcommittee and was a long-time employee at the U.S. Brooks Air Force Base where the military researched effects of electromagnetic radiation (EMR) and develops EMR weaponry.

Professor Anders Ahlbom

Professor Ahlbom was removed from IARC’s Expert Working Group to evaluate the potential carcinogenicity of radio frequency radiation the day before the meeting began, due to conflicts-of-interests. For some years, he had been a member of the Board of Directors of Gunnar Ahlbom AB, a lobby group headed by his brother Gunnar Ahlbom that had represented the interest of the leading Swedish mobile phone operator TeliaSonera, among others.

⁹⁷ http://ec.europa.eu/health/archive/ph_risk/committees/04_scenihr/docs/scenihr_o_022.pdf (accessed 6 Nov. 2013).

⁹⁸ It has changed its name to Swedish Radiation Safety Authority, SSM.

⁹⁹ http://www.emf.ethz.ch/archive/english/portrait_e.htm (accessed 5 Nov. 2013).

Anders Ahlbom chaired the expert group Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), and has served as a chair of ICNIRP from 1998-2008 (see Organizations below). Maria Feychting, his protégé, replaced him at ICNIRP.

As a project manager for the cellphone industry funded COSMOS study “on Oct. 6, 2011 an [Anders Ahlbom] email directly to Ericsson: one eleven - page application with project and budget plan for 2012 to 2014. He writes in the email that the funding requires a firewall agreement ‘preferably via Vinnova’.”¹⁰⁰

He was the lead author of ICNIRP’s Epidemiologic Evidence on Mobile Phones and Tumor Risk, A Review by ICNIRP’s Standing Committee on Epidemiology¹⁰¹: Anders Ahlbom, Maria Feychting, Adèle Green, Leeka Kheifets, David A. Savitz, Anthony J. Swerdlow.

Professor Vitas Anderson

He was a member of the IEEE 2005 Subcommittee and an industry consultant.

In a list of Awards and Grants, the list includes 2 from the Mobile Manufacturers Forum & GSMA Association, 2 from the Asian Office for Aerospace Research and Development (AOARD) of the United States Air Force Office of Scientific Research (AFOSR), 1 from the Mobile Manufacturers Forum, and 1 from the Australian Mobile Telecommunications Association & GSMA Association.¹⁰² He is “a former Telstra employee who represented Telstra’s interests on the former Standards Australia TE/7 standards committee.”¹⁰³

Professor Tadeusz Babiji

He was a member of the IEEE 2005 and is an industry consultant.

¹⁰⁰ Google Translation Swedish to English from

http://www.nyteknik.se/nyheter/it_telekom/mobiltele/article3483861.ece

¹⁰¹ CTIA Comments, footnote 108, page 23.

¹⁰² <http://www.swinburne.edu.au/lss/staff/view.php?who=vitasanderson> (accessed 26 Oct. 2013).

¹⁰³ www.emfacts.com/download/A_Machiavellian_Spin_Sept_2010.pdf (accessed 16 Oct. 2013)

Dr. William H. Bailey

He was a member of the IEEE 2005 Subcommittee and a Principal Scientist with the “Product Protection Firm,”¹⁰⁴ Exponent Inc. “Before joining Exponent, Dr. Bailey was President of Bailey Research Associates, Inc.”¹⁰⁵

Dr. Quirino (Q) Balzano

Q was Corporate Vice President and Director Motorola, Inc. September 1974 – January 2001.

Dr. David Black

Black was a member of the IEEE 2005 Subcommittee and an ICNIRP Consulting Expert. He is a past President of the Bioelectromagnetics Society (BEMS). “He has been involved in the development of the New Zealand and Australian RF standards. His practice is now divided between clinical and academic Occupational and Environmental Medicine and electromagnetic safety.”¹⁰⁶

Philip Chadwick

He was a member of the IEEE 2005 Subcommittee and an industry consultant with Microwave Consultants Ltd., UK. He is a President-Elect of the Bioelectromagnetics Society (BEMS).

Kwok W. Chan

He was an author of FCC’s Supplement C, which describes in copious detail how to implement the SAM Cellphone Certification Process. He is a scientist at the FCC and the brother-in-law of C-K Chou.

He is co-author with his brother-in-law on 13 science papers.¹⁰⁷

In an interview with Zoominfo:

“According to Mr. Chan, the FCC simply adopts the limits from different organizations and enforces the procedures for compliance with the limits and requirements. Mr. Chan explained that the limits are firmly established internationally and agreed upon by many experts so the FCC has ‘really no choice but to adopt’ these standards and enforce them. He

¹⁰⁴ A term used in David Michaels’ (current head of the U.S. Occupational Health and Safety Agency—OSHA) book, *Doubt Is Their Product, How Industry’s Assault on Science Threatens Your Health*.

¹⁰⁵ http://www.ct.gov/csc/lib/csc/pendingproceeds/docket_317/do317bailey.pdf (accessed 24 Oct. 2013).

¹⁰⁶ http://www.next-up.org/pdf/ICNIRP_CONSULTING_%20EXPERTS_01_2006.pdf (accessed 26 Oct. 2013).

¹⁰⁷ <http://www.ncbi.nlm.nih.gov/pubmed/?term=Chan+KW+AND+Chou+C-K> (accessed 7 Nov. 2013).

compared the FCC to an officer of the law who, unlike a judge, only enforces the law and is not meant to question it or change it. We are reaching out to the FCC because it is the last body in the chain of this process. By enforcing the standards, the FCC continues to support the established values without questioning the validity of them.”¹⁰⁸

Dr. Chung-Kwang (C-K) Chou

C-K Chou was chair of the Subcommittee that created the IEEE 2005 document. During this time he was a senior executive at Motorola’s Florida Research Labs. In 2009 when Motorola closed down his group, he was the sole person Motorola did not layoff. He was given the title Chief EME (electromagnetic energy) Scientist for Motorola’s Enterprise Mobility Solutions Division. Following Motorola’s sale of this division to Google, he continued at Motorola Solutions. He is an Associate Member of the Motorola Science Advisory Board (2005-) and the Science Adviser of Mobile Manufacturers Forum (2001 -).¹⁰⁹ His brother-in-law, Kwok Chan, is an author of the FCC’s Supplement C.

Dr. Joe A. Elder

He was employed by the Environmental Protection Agency (EPA) before joining Motorola. “Elder has changed his tune since joining Motorola a few years ago. He spent most of his professional career at the EPA where he worked on RF radiation and health. Back then, Elder had a radically different outlook. In the early 1980s, he was in charge of EPA’s RF health review. His 268-page report, Biological Effects of Radiofrequency Radiation, issued in 1984 after a rigorous external peer review, concluded, ‘[B]iological effects occur at an SAR of about 1 W/Kg; some of them may be significant under certain environmental conditions.’”¹¹⁰

“Joe Elder is now self-employed as a radiofrequency bioeffects consultant. He was employed by Motorola (until 2009) and his wife holds stock in Motorola. His participation as an Observer in this IARC Monographs meeting is sponsored by the Mobile Manufacturers Forum representing manufacturers of mobile and wireless communication devices and the network infrastructure that supports them.”¹¹¹

¹⁰⁸ <http://www.zoominfo.com/p/Kwok-Chan/72763339> (accessed 26 2013).

¹⁰⁹ <http://www.radiologymalaysia.org/Content/2007/BioMedPhysics/RFSafety.html> (accessed 15 Oct. 2013)

¹¹⁰ <http://microwavenews.com/news-center/industry-rules-rf-controlling-research-setting-standards-and-spinning-history> (access 26 Oct. 2013).

¹¹¹ IARC Monograph 109, p. 7.

“When George [Carlo] had begun the [CTIA-funded] WTR project he set up a peer review board through the Harvard Center for Risk Analysis. Wheeler now asked that peer review board’s membership be expanded to include Joe Elder, Peter Valberg and Asher Sheppard. Joe was at the EPA, but would later become a Motorola employee. Both Peter and Asher were receiving consulting contracts from Motorola. Motorola tried to rig the Peer Review Board with ‘friendlies’.”¹¹²

Dr. Linda Erdreich

She was a member of the IEEE 2005 Subcommittee and a long-term employee of the “Product Protection Firm,”¹¹³ Exponent Inc. As an Exponent “expert” she testified for the CTIA at a Senate Hearing in September 2009.

In the early 1990s, prior to working with Exponent, she worked with Bailey Research Associates (later to merge with Exponent), which was hired by the CTIA to support the CTIA-funded Wireless Technology Research (WTR) program. Of particular interest was her involvement with Joshua Muscat lead author of a study which was eventually published in December 2000.¹¹⁴

The involvement with Muscat came about as the result of the CTIA’s participation in a State the Science Colloquium held in June in connection with the annual meeting of Bioelectromagnetics Society (BEMS) where the CTIA-funded Muscat, post peer-review, study’s results were presented.¹¹⁵ The study showed a statistically significant risk of brain cancer from cellphone use (OR=2.6, 95% CI=1.2-5.4) with 34 cases and 34 controls.¹¹⁶

“The original peer-reviewed paper submitted by Muscat to the WTR in 1998, showed a statistically significant doubling in risk of rare neuroepithelial tumors. In the paper included in the book covering our State of the Science Colloquium in 1999, *Wireless Phones and Health* (Kluwer

¹¹² September 9, 2009: Excerpts of phone conversation notes with George Carlo (edited by George Carlo). Full document available upon request.

¹¹³ A term used in David Michaels’ (current head of the U.S. Occupational Health and Safety Agency—OSHA) book, *Doubt Is Their Product, How Industry’s Assault on Science Threatens Your Health*.

¹¹⁴ Muscat et al. Handheld Cellular Telephone Use and Risk of Brain Cancer, *JAMA*, December 20, 2000—Vol 284, No. 23.

¹¹⁵ The above paragraph is a synopsis of George Carlo’s book, *Cell Phones, Invisible Hazards in the Wireless Age, An Insider’s Alarming Discoveries About Cancer and Genetic Damage*, pages 177-178 and 210-211, 2001. Dr. George Carlo was hired by Tom Wheeler to the head the WTR research program.

¹¹⁶ *Wireless Phones and Health*, State of the Science, Kluwer Academic Publishers 2001.

Academic Press, 2001), also peer-reviewed, Muscat reported a statistically significant risk increase of neuroepithelial tumors. OR=2.6, 95% CI=1.2-5.4. Between 1999 and 2001, Muscat communicated frequently with Dr. Linda Erdreich, who had been hired by the CTIA to 'peer review' Muscat's paper. With Erdreich, Muscat became a consultant to the industry, participating in a number of industry sponsored scientific meetings across the globe during 2000.”¹¹⁷

When the Muscat paper was finally published in the Journal of the American Medical Association (JAMA), the number of cases and controls for neuroepithelial brain cancer had 35 and 14 compared to the State of the Science Colloquium where it was 34 and 34 respectively. The risk of neuroepithelial brain cancer changed from a significant 2.6-fold risk to a borderline significant risk, OR=2.1, 95% CI=0.9-4.7, calculated p-value=0.073. No explanation was ever given for the changes that occurred between the State of the Science peer-reviewed presentation and the peer-review publication in JAMA.

On page one, the CTIA Comments state, “Since [CTIA’s] formation in 1984, it has supported the industry’s voluntary efforts to promote the safe, responsible use of wireless products and services [p. 1].” The Wireless Technology Research project is the only example of such “voluntary efforts.”

*Professor Maria Feychting*⁶²

Maria Feychting is Anders Ahlbom’s protégé and he is her mentor. She is an ICNRIP Commissioner (replacing Ahlbom in 1998) and “participates” in the International EMF Project. She is an author of the ICNRIP review paper, “Epidemiologic Evidence on Mobile Phones and Tumor Risk.” She receives 4% of her total income from Norwegian expert group on high frequency electromagnetic fields; 3% of her total income from the Swedish Safety Authority and additional income from AGNIR. As an Interphone study Principal Investigator (PI) she received money from the Mobile Manufacturers Forum and the GSM Association. As a COSMOS study PI she has received and will continue to receive funds from TaliaSonera, Ericsson AB, Telenor. As a co-investigator on a childhood leukemia study she received funding from the Electric Power Research Institute (EPRI).

¹¹⁷ Email from George Carlo, 3 April 2008,

Dr. Arthur W (Bill) Guy

He was the chairman of the ANSI 1975 and 1982 standards, a member of the IEEE 2005 Subcommittee, an industry consultant and co-author with C-K Chou on 36 science papers.¹¹⁸ His work was funded by Motorola where he stated in a Microwave News article, “For all practical purposes, there is very little difference in peak SARs for different-sized heads”.¹¹⁹

In the 1990s he was with the “Scientific Advisory Group, Cellular Telecommunications Industry Association 1993 -- 1994; Chairman, Dosimetry Working Group, Wireless Technology Research [WTR], L.L.C. 1994-1997. IEEE Standards Coordinating Committee 28, Nonionizing Radiation, Vice Chairman 1989 - 1994, Subcommittee IV Human Safety Levels, Member 1989 – Present. Bioelectromagnetics Society President, 1983 - 1984; Member 1978 - Present”¹²⁰

He was a co-author with C-K Chou on a study, “Long-Term, Low-Level Microwave Irradiation of Rats” (see C-K Chou, above) which reported adverse effects from microwave radiation.

George Carlo recruited Guy to join the Wireless Technology Research (WTR) program funded by the CTIA.¹²¹ The CTIA funded the initial WTR Board which included Dr. Guy.¹²²

Given that exposure standards are based on the premise that the only biological effects from exposure to microwave radiation is heating the following conversation between George Carlo and Bill Guy where Guy appears to say there are non-thermal biological effects from microwave radiation. “George asks, ‘So the SAR is a measure of heating?’ Guy replies, ‘No, heat is a part of the formula to calculate it, but it measures the amount of energy passing through tissue during a time period. It’s more than heating.’ Carlo responds, ‘But if it depends on heat, it has to be a measure of heating.’ Guy replies, ‘It could be, but not always.’”¹²³

¹¹⁸ <http://www.ncbi.nlm.nih.gov/pubmed/?term=Chou+C-K+AND+Guy+AW> (accessed 7 Nov. 2013).

¹¹⁹ Microwave News May/June 2002 <http://microwavenews.com/news/backissues/m-j02issue.pdf> (Accessed 14 Oct. 2013).

¹²⁰ <http://www.arri.org/arthur-w-bill-guy-ph-d> (accessed 27 Oct. 2013).

¹²¹ George Carlo, *Cell Phones, Invisible Hazards in the Wireless Age*, p. 11.

¹²² George Carlo, *Cell Phones, Invisible Hazards in the Wireless Age*, p. 133.

¹²³ George Carlo, *Cell Phones, Invisible Hazards in the Wireless Age*, p. 20.

*Kenneth R. Foster*¹²⁴

He was a member of the IEEE 2005 Subcommittee and an industry consultant (Kenneth R. Foster & Associates, Electromagnetic Safety Consulting). In a consulting report he cited an Exponent Report, which cites the International EMF Project that no health problems exist.¹²⁵

A book *Phantom Risk, Scientific Interference and the Law* edited by Foster, has a chapter which he authored, “Weak Magnetic Fields: A Cancer Connection?” In this chapter he cites a 1990 David Savitz study,¹²⁶ which failed to find a risk, but fails to cite another 1990 Savitz study which found extraordinary risks for brain cancer, “Men employed in any electrical occupation had age race adjusted odds ratios (ORs) of 1.4 (95% confidence interval (CI) 1.1-1.7) for brain cancer. Brain cancer odds ratios were larger for electrical engineers and technicians (OR 2.7, 95% CI 2.1-3.4), telephone workers (OR 1.6, 95% CI 1.1-2.4), electric power workers (OR 1.7, 95% CI 1.1-2.7), and electrical workers in manufacturing industries (OR 2.1, 95% CI 1.3-3.4).”¹²⁷

James Hatfield

He was a member of the IEEE 2005 Subcommittee and an industry consultant.

Shiela Johnston

She was a member of the IEEE 2005 Subcommittee and an industry consultant.

Professor Leeka Kheifets

She was a member of the IEEE 2005 Subcommittee member, a long-term employee and on-going consultant for the Electric Power Institute (EPRI) and for various electrical utility corporations.

Shortly after founding the International EMF Project, Michael Repacholi recruited Kheifets to join him. After leaving the International EMF Project

¹²⁴ CTIA Comments, footnote 154 (citing International EMF Project), page 32.

¹²⁵ http://www.ripuc.org/efsb/SB%202008_02AdvisoryFoster_on_EMF_2_8_10.pdf (accessed 27 Oct. 2013).

¹²⁶ Savitz et al. Maternal employment and reproductive risk factors. *Am J Epidemiol.* 1990 Nov;132(5):933-45.

¹²⁷ Loomis & Savitz. Mortality from brain cancer and leukaemia among electrical workers. *Br J Ind Med.* 1990 Sep;47(9):633-8,

she became a “Professor-in-Residence” of Epidemiology at UCLA, though she continues to be funded by EPRI and by electrical utilities.

She is a member of the Independent Scientific Advisory Group to Swedish Radiation Safety Authority (SSM)¹²⁸ and a Member of ICNIRP’s Standing Committee on Epidemiology. She was a member of IARC’s Expert Workshop on ELF (Extremely Low Frequency) electromagnetic radiation which in 2001 declared such radiation to be a possible carcinogen. She voted in favor of this finding.

Her ICNIRP Declaration of Personal Interests outside income as a “Scientific expert, South Africa,” and from EPRI.

Professor Niels Kuster

Professor Kuster was a member of the Subcommittee which created IEEE 2005. He was an invited professor at the Electromagnetics Laboratory of Motorola, Inc., Florida, and is the founder and President of the Board of the sole-source manufacturer of the equipment required to use the SAM Process for cellphone certification, SPEAG (Schmid & Partner Engineering AG)

He attended the IARC Expert Working Group as an “Invited Specialist” when it declared radio frequency radiation was a possible carcinogen.

Patrick Mason

He was a member of the IEEE 2005 Subcommittee and was a long time employee at the U.S. Brooks Air Force Base where the military researches effects of electromagnetic radiation (EMR) and develops EMR weaponry.

Dr. Martin Meltz

He was a member of the IEEE 2005 Subcommittee and was a long time employee at the U.S. Brooks Air Force Base where the military researches effects of electromagnetic radiation (EMR) and develops EMR weaponry. Meltz was hired by the CTIA in February 1999 as a consultant to the WTR research projects.¹²⁹ He is cited 9 times in the context of his work with WTR in the index of Carlo’s book, *Cell Phones, Invisible Hazards in the Wireless Age*.

¹²⁸ Previously, SSI—Swedish Radiation Protection Authority

¹²⁹ George Carlo, *Cell Phone, Invisible Hazards in the Wireless Age*, p.161.

Joseph Morrissey (deceased)

He was a member of the IEEE 2005 Subcommittee and a Motorola employee. At the 2009 Bioelectromagnetics Meeting Morrissey was on the panel of the “Hot Topic Plenary: When Do We Know Enough To Stop Research on the Safety of Wireless Communications?” He took the position that it was time to stop all such research.

Dr. Michael Murphy

Murphy was a member of the IEEE 2005 Subcommittee and was a long time employee at the U.S. Brooks Air Force Base where the military researches effects of electromagnetic radiation (EMR) and develops EMR weaponry. He is a past President of the Bioelectromagnetics Society (BEMS).

Dr. John Osepchuk

He was a member of the IEEE 2005 subcommittee and an industry consultant and expert witness. He was employed by Raytheon Company in microwave R&D.

Dr. Ronald C. Peterson

He was Co-chairman of the IEEE 2005 Subcommittee and a paid industry consultant. He was employed by AT&T Bell Labs Lucent Technologies. He served as an expert witness for the CTIA testifying against San Francisco’s Right-To-Know ordinance.

Professor Michael Repacholi

In a Telstra¹³⁰ funded study to expose mice to cellphone radiation, Repacholi was the lead author of this study. The study reported a 2.4-fold statistically significant risk of lymphoma (see IEEE 2005 above).

Repacholi is the founder and first chairman of ICNIRP. He also founded the International EMF Project embedded within WHO where “up to half of the funds raised for his EMF Project came from industry.”¹³¹ “Last year, sensing that the upcoming [IARC](#) assessment might undercut his legacy at both the [WHO](#) and [ICNIRP](#), [Mike Repacholi](#) assembled a team to prepare its own assessment of the possible tumor risks from RF radiation:

¹³⁰ An Australian cellphone corporation.

¹³¹ <http://microwavenews.com/news-center/repacholi-half-who-emf-project-funding-came-industry> (accessed 28 Oct. 2013).

That [review](#),¹³² “Systematic review of wireless phone use and brain cancer and other head tumors,” has just been released by the journal *Bioelectromagnetics*.¹³³ This paper lists the following conflicts of interests: “PE [Paul Elliott] and AA [Anssi Auvinen] are Principal Investigators (PI) of the international COSMOS Study, which is a prospective cohort study investigating the possible long-term health effects of wireless phone use. PE receives funding from the UK Mobile Telecommunications and Health Research (MTHR) Programme (www.mthr.org.uk), an independent body set up to provide funding for research into the possible health effects of mobile telecommunications. MTHR is jointly funded by the UK Department of Health and the mobile telecommunications industry. PE's research is also supported by the Imperial College Healthcare NHS Trust Comprehensive Biomedical Research Centre, funded by the National Institute for Health Research (NIHR) and he is an NIHR Senior Investigator. AA receives research funding for the Finnish COSMOS component from the research programme of the National Technology Agency with contributions from network operators (TeliaSonera and Elisa) and Nokia. AA was the PI of the Finnish component of the Interphone consortium that was funded through the Fifth EU Framework programme, with partial funding from the Mobile Manufacturers Forum and the GSM Association (with UICC as the firewall). All other authors reported no conflicts of interest.” Repacholi did not declare a conflict of interest.

J. Patrick Reilley

He was a member of the IEEE 2005 subcommittee and is an industry consultant.

Jack Rowley

Jack Rowley is employed by the GSM Association (GSMA) whose member companies use radiofrequency radiation to deliver communication services. GSMA, like the CTIA, has a large number of Full Members, Associate Members, and Rapporteur Members. Their memberships spans a greater reach than the CTIA, which is mostly based in the United States (GSMA has 55 full members in the USA—many overlapping with CTIA).

He has represented the GSM Association in government inquiries in North America and at workshops organized by the European Commission and

¹³² Repacholi et al. Systematic review of wireless phone use and brain cancer and other head tumors. *Bioelectromagnetics* Volume 33, Issue 3, pages 187–206, April 2012

¹³³ <http://microwavenews.com/short-takes-archive/repacholis-rf-review> (accessed 28 Oct. 2013).

national authorities. His participation as an “Observer” in this IARC Monographs meeting is sponsored by the GSM Association.¹³⁴

Dr. David A Savitz

A member of the IEEE 2005 Subcommittee, a well-paid “expert” witness for industry¹³⁵ and an ICNRIP advisory member.

Dr. Asher Sheppard

He was a member of the IEEE 2005 subcommittee and is an industry consultant. He was a consultant for Motorola. Motorola nominated him to serve as a peer reviewer for CTIA financed WTR science studies.¹³⁶

Dr. Joachim Schüz

He has been a first or last author on 5 of the 6 studies of the industry-funded Danish Cellphone Subscriber Cohort Study.

Schüz spent many years at the Danish Cancer Registry but then moved to IARC.

He has been and/or continues to be funded by the Electric Power Research Institute (since 2006). As a project manager for the COSMOS Study he has received and will continue to receive funds from TaliaSonera, Ericsson AB, and Telenor. As the German Interphone study PI he received funds from MMF, and the GSMA.

He participated in the production of the SCENIR opinion published in January 2009.

Professor Anthony (Tony) Swerdlow

He is a former ICNRIP Commissioner and a current Chairman of AGNIR.

Professor Swerdlow’s conflicts-of-interest with the cellphone industry were disclosed in an ICNRIP paper which stated “A.J.S. has been provided by a number of sources, including the European Fifth Framework Program; the International Union against Cancer, which receives funds from the Mobile Manufacturers’ Forum and the GSM Association; the Mobile

¹³⁴ IARC Monograph 109, p. 8.

¹³⁵ Deposition of David Savitz, United States District Court, Portland, OR Plaintiffs v. Portland Public Schools CV No. 11-739-MO, p. 38-39, lines 6-9.

¹³⁶ George Carlo, Cell Phones, Invisible Hazards in the Wireless Age, p. 42.

Telecommunications Health and Research Programme; the Swedish Research Council; AFA Insurance; and VINNOVA (Swedish Governmental Agency for Innovation Systems). VINNOVA received funds from TeliaSonera, Ericsson, and Telenor ... A.J.S. holds shares in the telecoms companies Cable and Wireless Worldwide and Cable and Wireless Communications. A.J.S.'s wife holds shares in the BT group, a global telecommunications services company.”

Dr. M (Mays) L. Swicord

His PhD thesis reported microwave radiation effected DNA. He was chief of the Radiation Biology Branch at FDA’s CDRH and left the FDA in 2003 for Motorola where he was the Director of Electromagnetic Energy Programs at Motorola’s Florida Research Labs. In 2004, while at Motorola, he spoke on behalf of the Mobile Manufacturers Forum (MMF) at a seminar held in Brussels”¹³⁷ He was an “Observer” at IARC’s Expert Workshop, sponsored by the CTIA, which declared radio frequency radiation is a possible carcinogen.

Richard Tell

He was member of the IEEE 2005 subcommittee and is an industry consultant.

Eric van Rongen

He was a member of the IEEE 2005 subcommittee and an industry consultant. He is an ICNRIP Commissioner.

The Stability of Brain Cancer Incidence Rates?

A paragraph on page 23 of the CTIA Comment stated:

“Perhaps most tellingly, while cell phone use has increased dramatically all over the world, there has not been any corresponding rise in the incidence of brain cancer. In fact, brain tumor rates have remained flat or even fallen slightly here in the United States.”¹³⁸ Researchers comparing actual incidence with rates predicted by those who believe RF emissions cause brain cancer have found that actual incidence rates are at least 40 percent lower than such

¹³⁷ Microwave News 2004 <http://microwavenews.com/news/mobile-phones-again-linked-tumor-risk> (Accessed 14 Oct. 2013).

¹³⁸ Inskip et al. Brain Cancer Incidence Trends in Relation to Cellular Telephone Use in the United States, 12 Neuro-Oncology 1147 (2010). Actual footnote is an NCI statement referring to this paper.

predictions.¹³⁹ The same is true in European countries where cell phones were adopted relatively early in comparison to the United States. After studying brain cancer incidence in Sweden, Finland, Denmark and Norway from 1979-2008, IARC researchers and authorities in these countries found **incidence rates to be generally stable** over the entire period [**emphasis added.**]¹⁴⁰

Each of these studies had various methodological problems which tend to obscure the reality. This will be discussed below, but first we will examine the reality.

Four countries have reported a doubling of the worst brain cancer, glioblastoma multiforme (GBM). They are the Australia, Denmark, Norway and the United States.

A 2011 Australian study which examined brain cancer incidence rates for the years 2000-2008 reported “A significant increasing incidence in glioblastoma multiforme (GBM) was observed in the study period (annual percentage change [APC], 2.5; 95% confidence interval [CI], 0.4–4.6, n = 2275), particularly after 2006.”¹⁴¹

The Danish Cancer Registry reported on 2 Nov. 2012, “The number of men who are diagnosed with the most malignant form of brain cancer (glioblastoma), has almost doubled over the past ten years.”¹⁴²

In Norway, brain and central nervous system cancer, during the latest 10 years, increased annually at 2.8% per year in women and 1.8% per year in men.¹⁴³

In the United States a study which examined brain cancer incidence rates for the years 1992-2006 reported, “Data from 3 major cancer registries demonstrate increased incidences of GBMs in the frontal lobe, temporal lobe, and cerebellum,

¹³⁹ Little et al. Mobile phone use and glioma risk: comparison of epidemiological results with incidence Little et al. Mobile phone use and glioma risk: comparison of epidemiological results with incidence

¹⁴⁰ Deltour et al. Mobile phone use and incidence of glioma in the Nordic countries 1979-2008: Consistency check. 23 Epidemiology 301 (2012).

¹⁴¹ Dobes et al. Increasing incidence of glioblastoma multiforme and meningioma, and decreasing incidence of Schwannoma (2000-2008): Findings of a multicenter Australian Study. [Surg Neurol Int.](#) 2011;2:176. doi: 10.4103/2152-7806.90696. Epub 2011 Dec 13.

¹⁴² <http://www.cancer.dk/Nyheder/nyhedsartikler/2012kv4/Kraftig+stigning+i+hjernesvulster.htm> (Danish to English translation, accessed 31 Oct. 2012).

¹⁴³ <http://www.saferphonezone.com/site/wp-content/uploads/2011/11/NorwegianBrainCancer.pdf> (accessed 15 Nov. 2013).

despite decreased incidences in other brain regions.¹⁴⁴ The frontal lobe, temporal lobe and cerebellum absorb 81% (900 MHz) and 86% (1800 MHz) of all the cellphone radiation absorbed by the brain¹⁴⁵.

It is curious that the CTIA did not cite these studies though each was published well before the CITA Comments were submitted.

Of the 3 studies the CTIA cited:

1. The first study¹⁴⁶ examined incidence for the years 1992-2006 and reported “[R]ates among whites, [w]ith the exception of the 20-29-year age group, the trends for 1992-2006 were downward or flat. Among those aged 20-29 years, there was a statistically significant increasing trend between 1992 and 2006 among females but not among males. The recent trend in 20-29-year-old women was driven by a rising incidence of frontal lobe cancers (the frontal lobe absorbs 19% (800 MHz) and 14% (1800 MHz) of the total cellphone radiation absorbed by the brain.”
2. The second study¹⁴⁷ (with overlapping authors from the first study) examined brain cancer incidence 1997-2008 and reported “Age specific incidence rates of glioma remained generally constant in 1992-2008 ... a period coinciding with a substantial increase in mobile phone use from close to 0% to almost 100% of the US population.”

In 1997, 25% of the U.S. population was using a cellphone. The average latency time for brain cancer is 30+ years. The paper stated the “*Minimum* latency periods of up to 10 years are *thought to apply* for mobile phone exposure” [*emphasis added*]. Therefore, according to the authors, the *minimum* time when an increase could possibly be detected was 2007, but the incidence data ended in 2008.

3. The third study¹⁴⁸ examined brain cancer incidence from 1979-2008. Its funding was from the “Danish part of the COSMOS study”¹⁴⁹ with

¹⁴⁴ Zada et al. Incidence Trends in the Anatomic Location of Primary Malignant Brain Tumors in the United States: 1992–2006. *World Neurosurg.* 2012 Mar-Apr;77(3-4):518-24. doi: 10.1016/j.wneu.2011.05.051. Epub 2011 Nov 7.

¹⁴⁵ Cardis et al. Distribution of RF energy emitted by mobile phones in anatomical structures of the brain. *Phys. Med. Biol.* 53 (2008) 2771–2783.

¹⁴⁶ Inskip et al. Brain Cancer Incidence Trends in Relation to Cellular Telephone Use in the United States, 12 *Neuro-Oncology* 1147 (2010). Actual footnote is an NCI statement referring to this paper.

¹⁴⁷ Little et al. Mobile phone use and glioma risk: comparison of epidemiological results with incidence Little et al. Mobile phone use and glioma risk: comparison of epidemiological results with incidence

¹⁴⁸ Deltour et al. Mobile phone use and incidence of glioma in the Nordic countries 1979-2008: Consistency check. 23 *Epidemiology* 301 (2012).

¹⁴⁹ <http://www.thecosmosproject.org/funding.php> (accessed 31 Oct. 2013).

additional funding from the GSM Association and Mobile Manufacturers Forum. It concludes, “Our data indicate that, so far, no risk associated with mobile phone use has manifested in adult glioma incidence trends, although the induction period, if any, is unknown.” In 1979 there were no cellphone users in the world!

Normal Operating Positions

The FCC rules require that the exposure limits “For purposes of evaluating compliance with localized SAR guidelines, portable devices¹⁵⁰ should be tested or evaluated based on **normal operating positions** or conditions [Bulletin 65, p. 42 **emphasis added**].”

The GAO Report “Exposure and Testing Requirements for Mobile Phones Should Be Reassessed” in a sidebar on its opening page titled “**What GAO Recommends**” [emphasis in original] stated, “FCC should formally **reassess and, if appropriate, change** its current RF energy exposure limit and mobile phone **testing requirements related to likely usage configurations**, particularly when phones are held against the body [**emphasis added**].”

Clearly this is being ignored both by the FCC and by the cellphone companies who place warnings in the commonly unread cellphone manuals. Every cellphone manual has a warning that the cellphone model must be kept at certain distances away from the users’ bodies or the exposure limits can be exceeded.

In the CTIA Comments, footnote 177 (page 38) refers the reader to an iPhone User Guide, but fails to direct the reader to “Go to Settings > General > About > Legal > RF Exposure” where warnings are found to maintain a 10 mm distance (~3/8 inch) from the body in order to not exceed the exposure limits. The screenshot is below.

In the above, Other Issues with the Current FCC Cellphone Certification Process section shows the iPhone 5 exceeds the exposure limits even at a 10 mm distance 21 times. Virtually all cellphone manuals have similar warnings. This is clearly a contradiction to the FCC’s admonition “portable devices¹⁵¹ should be tested or evaluated based on normal operating positions or conditions.” The GAO Report is cited by the CTIA Comments 22 times, but fails to mention the most important item from the GAO Report.

¹⁵⁰ In the FCC’s language “portable devices” are cellphones; laptops, tablets and similar devices are “”

¹⁵¹ In the FCC’s language “portable devices” are cellphones; laptops, tablets and similar devices are “”



Watts per Kilogram (over a volume containing a mass of 1 gram of tissue) in countries that follow the United States FCC limit and 2.0 W/Kg (averaged over 10 grams of tissue) in countries that follow the Council of the European Union limit. During testing, iPhone radios are set to their highest transmission levels and placed in positions that simulate use against the head, with no separation, and near the body, with 10 mm separation.

To reduce exposure to RF energy, use a hands-free option, such as the built-in speakerphone, the supplied headphones, or other similar accessories. Carry iPhone at least 10 mm away from your body to ensure exposure levels remain at or below the as-tested levels. Cases with metal parts may change the RF performance of the device, including its compliance with RF exposure guidelines, in a manner that has not been tested or certified.

SAR values for this device are available at:

www.apple.com/legal/rfexposure/iPhone4,1/en/

Although this device has been tested to determine SAR in each band of operation, not all bands are available in all areas. Bands are dependent on your service provider's wireless and roaming networks.

The most important item in the GAO Report is on the opening page, under the heading, “**What GAO Recommends**”, states, “FCC should formally reassess and, if appropriate, change its current RF energy exposure limit and mobile phone testing requirements related to likely usage configurations, particularly when phones are held against the body.”

The FCC has two nomenclatures for wireless devices: “Portable” devices for cellphones, and “Mobile” devices for laptop computers and tablets (e.g., iPads).

The exposure limit for the cellphones is a SAR=1.6 W/kg for “normal operating positions”; for the latter the FCC has very different language.

But for laptop computers and tablets there is a very different rule: “For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons [Bulletin 65, p. 40].”

Twenty centimeters (20 cm) is approximately 8 inches. The very name “laptop” means that it is not “used in such a manner that a separation distance of at least 20 cm is normally maintained. Indeed advertisements show usages far closer than 20 cm by children and adults.¹⁵² At ½ inch the radiation from the laptop can exceed the exposure limit 256-fold!



Science Studies Reporting Adverse Health Effects

Epidemiology—Risk to Children

In regards to Children the CTIA Comments has a whole section titled “Current Emission Standards and Testing Procedures are Safe and Appropriate for Children,” [p. 26-20] which asserts “The scientific consensus also supports the

¹⁵² <https://www.google.com/search?q=Children+%26+ipad&client=firefox-a&hs=75L&rls=org.mozilla:en-US:official&tbm=isch&tbo=u&source=univ&sa=X&ei=xAJ0UvTmG-O1iwLdh4HgAg&ved=0CEMQsAQ&biw=1246&bih=446&dpr=1.25> (access 1 Nov. 2013).

Commission's existing emission standards [are protective of children]. The Commission, as well as the expert agencies on which it relies for guidance, reached this conclusion when developing those standards. No change in the state of the science warrants reconsidering them."

The Commission reached its conclusion 18 years ago. In the intervening years there has been a host of science studies which have found that the existing standard **is not protective of children**. As noted above in the IEEE 2005, *Concerns* section above there are **5 studies which reported effects on children**. IEEE 2005 is the very standard with calls for increasing (AKA "harmonizing") the exposure limits which will increase allowed absorption of microwave radiation up to 3-times higher than the existing limit.

What follows are epidemiology studies which have reported significant risks to children after the existing limits were adopted 18 years ago:

1. In 2009 a study reported when cellphone or cordless phone use began as a teenager or younger, the statistically significant risk of brain cancer on the same side of the head where the cellphone was held was 8-fold. In comparison, adults had a statistically significant 2-fold risk.¹⁵³

In other words, **children's risk of brain cancer was 4-times higher than adults' risks**.

2. In 2011 an industry funded study (CEFALO) found for **children between the ages of 7-19 (median age 13)**, using Operator Data (billing records) a statistically significant greater than **doubled risk of brain cancer** with >2.8 years since first use. This finding was combined with a highly significant dose-response relationship (increased years of use, increased the risk for brain cancer, $p=0.001$).¹⁵⁴ CEFALO was funded by the Swiss Research Foundation on Mobile Communication (FSM) whose funding came from industry. For details see **Credibility of Sources, Organizations** above.

It is well known that when exposed to any carcinogen, the risk is higher in children compared to adults. And the younger the child when exposed, the higher the risk. This well-known reality may be because

¹⁵³ Hardell & Carlberg. Mobile phones, cordless phones and the risk for brain tumours. INTERNATIONAL JOURNAL OF ONCOLOGY 35: 5-17, 2009.

¹⁵⁴ Aydin et al. Mobile Phone Use and Brain Tumors in Children and Adolescents: A Multicenter Case-Control Study. JNCI Vol. 103, Issue 16 | August 17, 2011

the younger the child the higher the rate of cell division in their bodies. Two examples of this phenomenon are shown below:

1. A 2005 study of young children (average age 7.1 years) exposed to ionizing radiation found for <5 years old a 356% increased risk/Gy for brain cancer; for 5-9 years old, a 224% increase and; for 10 or more years of age, a 47% increase.¹⁵⁵ That is, the younger the child, the higher the risk.
2. In 1993 a study showed the risk of lung cancer was higher when smoking began as a teenager or younger compared to adults; >12-fold compared to 6-fold.¹⁵⁶ When smoking begins as a child the risk is higher than when smoking begins as an adult.

Epidemiology Risk to Adults

Brain Cancer

1. The CTIA Comments (p. 21) asserts “In 2000, researchers conducting a hospital-based case-control study in the United States found no evidence of increased risk of brain cancer and cell phone use.” This is not true this CTIA-funded study found a 2.6-fold borderline significant (93% confidence) risk of brain cancer from cellphone use. As noted above an earlier peer-reviewed publication reported a statistically significant risk of brain cancer, OR=2.6, 95% CI=1.2-5.4 (for details see Dr. Linda Erdreich above).
2. A 2007 Swedish study of brain cancer reported:
Risk of high-grade brain cancer¹⁵⁷ for >10 years since first analog cellphone use, OR=2.7, 95% CI=1.8-4.2; similarly for cordless phone use, OR=2.2, 95% CI=1.3-3.9; and a *dose-response* relationship,¹⁵⁸
An increased risk of high-grade brain cancer per year since first digital cellphone use, OR=11%, 95% CI=6%-16%; for cordless phone use, OR=8%, 95% CI=5%-12%;
Per every 100 cumulative hours of digital cellphone use, the increased risk of high-grade brain cancer was, OR=4%, 95% CI=2%-6%; cordless phone use, OR=2%, 95% CI=1%-3%.

¹⁵⁵ Sadetzki et al. Radiation Research. V 163 2005.

¹⁵⁶ Hegmann et al. 1993.

¹⁵⁷ Astrocytoma

¹⁵⁸ Mild et al. Pooled Analysis of Two Swedish Case-Control Studies on the Use of Mobile and Cordless Telephones and the Risk of Brain Tumours Diagnosed During 1997–2003. JOSE 2007, Vol. 13, No. 1, 63–71.

3. A 2013 study by the same Swedish team,¹⁵⁹ the only study to report risks beyond 10 years and up to more than 25 years of use, found statistically significant risks.

The risks for brain cancer from wireless phone use (cell & cordless) for >15-20, OR=1.7, 95% CI=1.02-3.0; >20-25, OR=1.9, 95% CI=1.04-3.4, and >25 years, OR=3.0, 95% CI=1.5-6.0.

Again, this study found dose-response relationships: For every 100 cumulative hours of wireless phone use the risk increased, OR=0.9%, CI=0.6%-1.2%, and for every year since first wireless phone the risk increased, OR=1.8%, 95% CI=0.1%-3.6%.

The temporal lobe absorbs the larger proportion of cellphone radiation of any anatomical region of the brain. This study examined the risk temporal tumors combined with temporal lobe tumors which overlapped into the frontal, parietal and occipital lobes. The risk of brain cancers in these regions from wireless phone use reported was, for >15-20 years, OR=2.3, 95% CI=0.9-5.8; >20-25 years, OR=2.7, 95% CI=1.04-7.2; >25 years, OR=5.1, 95% CI=1.8-15).

4. In 2010 the industry and government funded Interphone study was published.¹⁶⁰

For regular use (at least once a week, for 6 months or more the risk of glioma (a subset of all brain cancers) found *statistically significant protection* from glioma¹⁶¹, OR=0.81, 95% CI=0.70-0.94. This protective effect is the result of design flaws which underestimated the risk.¹⁶² The authors of the study recognized the problem and noted "... bias may have led to a reduction in the ORs for regular use ... [for] glioma (19%, 95% CI 30-6) [sic]¹⁶³."

¹⁵⁹ Hardell et al. Case-control study of the association between malignant brain tumours diagnosed between 2007 and 2009 and mobile and cordless phone use. *Int J Oncol.* 2013 Dec;43(6):1833-45.

¹⁶⁰ The INTERPHONE Study Group. Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study. [Int J Epidemiol.](#) 2010 Jun;39(3):675-94. doi: 10.1093/ije/dyq079. Epub 2010 May 17.

¹⁶¹ Glioma, is a cancer of glial cells in the brain.

¹⁶² Morgan LL. Review, Estimating the risk of brain tumors from cellphone use: Published case-control studies. *Pathophysiology* 16 (2009) 137-147.

¹⁶³ Should be CI 6%-30%.

In spite of this underestimation of risk, they found after >10 years combined with $\geq 1,640$ cumulative hours of cellphone use, a significant risk, OR=1.57, 95% CI=1.13-2.30, arguably the reported risk should be 1.86, which is 19% larger than the published risk of 1.57.

When the authors recognized this issue they decided to assess risk within users and use very low levels of exposure as the referent level rather than non-exposed subjects. When they performed this analysis they reported a doubled risk of brain cancer. For >10 years of cellphone use compared to 1-1.9 year of use, the risk more than doubled, OR=2.18, 95% CI=1.43-3.31; for $\geq 1,640$ cumulative hours of use compared to <5 hours of use, the risk almost doubled, OR=1.82, 95% CI=1.15-2.89.

Acoustic Neuroma (a tumor of the hearing nerve)

The CTIA Comments claims,

“A wide range of studies, conducted in a variety of scientific disciplines using data from a number of different countries, have reached the same conclusion: Cell phones are not associated with increased health risks. For example, as the WHO and the Commission have both noted, the 2010 Interphone study, which drew on data from 13 participating countries, found no overall increased risk of glioma, meningioma or acoustic neuroma with mobile phone use of more than 10 years.⁹⁸ The Interphone study is the largest case-control study conducted to date. Similarly, a large cohort study following cell phone users in Denmark from 2001 to 2011 has found no association between cell phone use and glioma, meningioma or acoustic neuroma.”

The above claim is far from the truth. The 2010 Interphone study was not a study of the risk of acoustic neuroma. It was a study of the risk of glioma and meningioma. As noted in preceding paragraphs the 2010 study found significantly increased risks of glioma.

What follows is a list of studies which have found significant risk of acoustic neuroma:

1. The first study to report a risk of acoustic neuroma from cellphone use was published in 2002.¹⁶⁴ For analogue cellphone use¹⁶⁵ they more than a tripled significant risk, OR=3.5, 95% CI=1.6-2.8.

¹⁶⁴ Hardell et al. Cellular and cordless telephones and the risk for brain tumours. European Journal of Cancer Prevention 2002, 11, 1-10.

2. Two years later, in 2004 the industry and government funded Swedish Interphone study reported an ipsilateral risk for >10 years since cellphone use began, they found an almost quadrupled risk, OR=3.9, 95% CI=1.6-9.5.¹⁶⁶ This result is *statistically identical* to the first study (this study's confidence interval spans the first study's confidence interval).
3. A year later, in 2005, a study¹⁶⁷ found the risk acoustic neuroma with >64 cumulative hours of digital phone use was, OR=1.5, 95% CI=0.99-2.3. With ipsilateral digital cellphone use, OR=1.7, 95% CI=1.1-2.6; for ipsilateral cordless phone use, OR=1.7, 95% CI=1.1-2.6).
4. In early 2010 a Japanese Study¹⁶⁸ found the heaviest cellphone users (>20 min/day) from both 1 and 5 years prior to diagnosis a quintupled relative risk, RR=5.0, 95% CI=1.4-24.8.
5. A year later, the 13-country, industry and government funded Interphone study published its 2011 study of acoustic neuroma.¹⁶⁹ With $\geq 1,640$ cumulative hours of cellphone use, 5 years prior to the date of diagnosis they reported close to a triple risk, OR=2.79, 95% CI=1.51-5.16. With ipsilateral use, for $\geq 1,640$ cumulative hours of cellphone use, 5 years prior to the date of diagnosis the risk more than tripled, OR=3.53, 95% CI=1.59-7.82. With >10 years of use combined with >1,640 cumulative hours the risk was even larger, OR=3.74, 95% CI=1.58-8.83.
6. In May 2013 a UK study reported a more than tripled significant risk of acoustic neuroma with 10 or more years of cellphone use, OR=3.11, 95% CI=1.08-8.95).¹⁷⁰
7. A July 2013 paper reported wireless phone use for various ranges of time up to more than 25 years.¹⁷¹ Also it is *the first study to show that the size of acoustic neuroma tumor increases with increasing microwave radiation exposure*. The following results were found:

¹⁶⁵ Analogue cellphone were the 1st generation cellphones. They only transmitted maximum power and they have consistently shown a higher risk than later generations of cellphones

¹⁶⁶ Lönn et al. Mobile Phone Use and the Risk of Acoustic Neuroma. Epidemiology • Volume 15, Number 6, November 2004.

¹⁶⁷ Hardell L, Carlberg M, Hansson Mild K. Pooled analysis of two case-control studies on the use of cellular and cordless telephones and the risk of benign brain tumours diagnosed during 1997-2003. Int J Oncol. Published online: June 13, 2005

¹⁶⁸ Sato et al. A Case-Case Study of Mobile Phone Use and Acoustic Neuroma Risk in Japan. Bioelectromagnetics, 2011 Feb;32(2):85-93. Epub 2010 Oct 28.

¹⁶⁹ The CTIA Comments stated (p. 21), "the 2010 Interphone study, which drew on data from 13 participating countries, found no overall increased risk of ... acoustic neuroma with mobile phone use of more than 10 years."

¹⁷⁰ Benson et al. Mobile phone use and risk of brain neoplasms and other cancers: prospective study. Int J Epidemiol. 2013 Jun;42(3):792-802.

¹⁷¹ Hardell et al. Pooled analysis of case-control studies on acoustic neuroma diagnosed 1997-2003 and 2007-2009 and use of mobile and cordless phones. Int J Oncol. 2013 Oct;43(4):1036-44. doi: 10.3892/ijo.2013.2025. Epub 2013 Jul 22.

- a. Increase in tumor volume per year since first analog¹⁷² cellphone use, 7.4%, 95% CI=1.0%-14.2%, p=0.02; increase per 100 hours of cumulative analog cellphone use 10.3%, 95% CI=2.4%-8.7%, p=0.01;
 - b. Increase in tumor volume per years since first use of wireless phones (cell and cordless), 3.6%, 95% CI=-1.1%-8.6%, p=0.13; increase per 100 hours of cumulative wireless phones use, 1.0%, 95% CI=0.1%-2.2%, p=0.08;
 - c. Dose-response relationships: Increase risk per year since first wireless phone use, OR=5.6%,¹⁷³ 95% CI=2.9%-8.5%, and per 100 cumulative hours of wireless phone use, OR=0.8%, 95% CI=0.2%-1.4%.
 - d. With more than 20 years of wireless phone use, OR=4.4, 95% CI=2.2-9.0.
8. One month later (August 2013) a Korean Study also reported the acoustic neuroma tumor size increased with increased exposure.¹⁷⁴ The tumor volume in cubic centimeters (cm³) was compared from long-term use versus short-term use. The results were:
- a. Duration of use, <10 years to >10 years: 5.57 cm³ to 9.93 cm³ (176% increase);
 - b. Daily use, <20 min/day to >20 min/day: 4.88 cm³ to 11.32 cm³ (232% increase);
 - c. Cumulative hours of use, <2,000 hours to >2,000 hours: 4.88 cm³ to 13.31 cm³ (273% increase).

It is hard to ignore 8 studies from 7 teams in 6 countries,¹⁷⁵ where with one exception (5 above), the CTIA Comments ignored these studies, and claimed (p. 20-21)

“A wide range of studies, conducted in a variety of scientific disciplines using data from a number of different countries, have reached the same conclusion: Cell phones are not associated with increased health risks. For example, as the WHO and the Commission have both noted, the 2010 Interphone study, which drew on data from 13 participating countries, found no overall increased risk of ... acoustic neuroma with mobile phone use of more than 10 years.”

Parotid gland (a large salivary gland in the cheek) tumors

¹⁷² Analog cellphone were the first generation cellphones. They radiated maximum power at all times.

¹⁷³ After 20 years of a 5.6% increase per year, the risk increases 2.97-fold

¹⁷⁴ Moon et al. Association between vestibular schwannomas and mobile phone use. Tumour Biol. 2013 Aug 27. [Epub ahead of print]

¹⁷⁵ 13-country Interphone studies counted as single country

The CTIA Comments fails to mention any risk of parotid gland tumors.

Four studies have reported risk of parotid gland tumors from cellphone use:

1. A 2006 joint Danish-Swedish industry and government funded Interphone study found for >10 years of ipsilateral cellphone use a borderline significant risk, OR=2.6, 95% CI=0.9-7.9, calculated $p=0.078$.¹⁷⁶

Several of the authors of this study are discussed above in the **Credibility of Sources, Individuals** section above. They are Anders Ahlbom, Joachim Schüz, and Maria Feychting.

In 2006 the Israel Dental Association issued a warning which was reported in the Israeli newspaper, Haaretz. This article noted a disproportion number of these tumors in young people, “salivary gland cancer...was disproportionately common among young patients. One fifth of those patients were under 20. Oral cancers are associated with a high mortality rate in Israel, with patients living an average of five and a half years.”¹⁷⁷

2. A 2007 industry and government funded Israel Interphone study reported the risk to “Mainly rural or mixed rural/urban” cellphone users.¹⁷⁸ This subgroup was selected because cellphones radiate higher power in rural areas compared to urban areas as the base stations (cell towers) are typically farther away from users compared to urban users. The risk to rural or mixed rural urban cellphone users with cumulative number of calls $\geq 18,997$ was OR=1.81, 95% CI=1.04-3.14; for cumulative call times $>1,035$ hours, OR=1.96, 95% CI=1.11-3.44.
3. In January 2011 an Israel study examined the risk of parotid gland tumor from 1970-2006.¹⁷⁹ This study showed a sharp rise in the number of parotid gland tumor relative to other salivary gland tumors beginning around 1990. This is illustrated by Figure 1 from the study.

¹⁷⁶ Lonn et al. Mobile Phone Use and Risk of Parotid Gland Tumor. Am J Epidemiol. 2006 Oct 1;164(7):637-43. Epub 2006 Jul 3.

¹⁷⁷ <http://www.haaretz.com/print-edition/news/israeli-study-sees-link-between-oral-cancer-cell-phones-1.280073> (accessed 4 Nov. 2013).

¹⁷⁸ Sadetzki et al. Cellular Phone Use and Risk of Benign and Malignant Parotid Gland Tumors—A Nationwide Case-Control Study. Am J Epidemiol. 2008 Feb 15;167(4):457-67. Epub 2007 Dec 6

¹⁷⁹ Czerninski et al. Risk of Parotid Malignant Tumors in Israel (1970–2006). Epidemiology: January 2011 - Volume 22 - Issue 1 - pp 130-131.

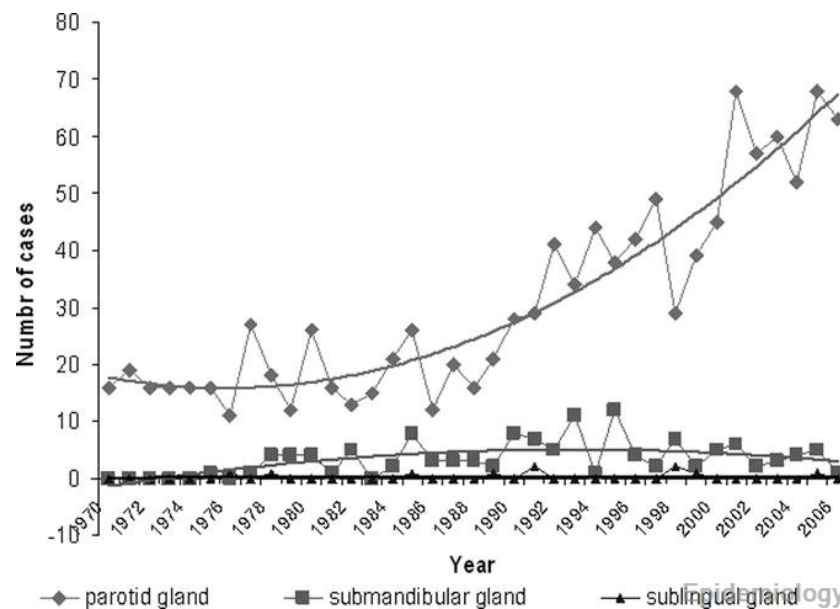


Figure 1. For trend analyses, we added regression lines and calculated R2 values. Parotid gland cancer: R2 = 0.83; Submandibular gland cancer: R2 = 0.36; Sublingual gland cancer: R2 = 0.02.

4. In April 2011 a Chinese study was published on the risk of parotid gland tumors.¹⁸⁰ This study found extraordinarily high risks (similar risk to what has been found with smoking and the risk of lung cancer):
 - a. The risk of two parotid gland variants, epithelial parotid gland malignancies, and mucoepidermoid carcinoma, with >10 years since first use was, OR=10.63, 95% CI=5.31-21.3, and OR=20.73, 95% CI=9.38-45.8, respectively;
 - b. With average daily use of >2.5 hour per day, OR=15.88, 95% CI=5.98-42.2, and OR=31.3, 95% CI=10.8-90.5, respectively.

Leukemia

The CTIA Comments ignored reported risks of leukemia from cellphone use. Two studies have reported risk of leukemia from cellphone use:

1. In 2009 a study in Thailand found, after adjusting for age, sex, income; use of cellphones; benzene and other solvent exposures; occupational and non-occupational pesticide exposures; pesticides used near the home; working with power lines, living near power lines, the risk from exclusive use of a 2nd generation GSM cellphone, OR=3.0, 95% CI=1.4-

¹⁸⁰ Duan et al. Correlation between cellular phone use and epithelial parotid gland malignancies. [Int J Oral Maxillofac Surg](#). 2011 Sep;40(9):966-72. doi: 10.1016/j.ijom.2011.03.007. Epub 2011 Apr 6.

- 6.4. For any cellphone use, the high risk was for chronic myelogenous leukemia (CML), OR=2.3, 95% CI=1.0-5.5.¹⁸¹
2. An industry-funded¹⁸² UK study published in 2010, found for ≥ 15 years since first cellphone use a borderline significant risk of leukemia, OR=1.87, 95% CI=0.96-3.63, calculated $p=0.060$ (94% confidence).¹⁸³ The team leader of this study was Anthony Swerdlow (see **Credibility of Sources, Individuals** above).

Breast Cancer

The CTIA Comments makes no mention of breast cancer from cellphones. There are women, particularly young women, who place their cellphones in their bras. Arguably, the female breast is the most absorbent tissue in the human body, with the brain, perhaps being the second most absorbent tissue.

A case series report was published in 2013 finding multi-focal (multiple-primary) breast cancers¹⁸⁴ that occurred in the center of their chests precisely where these women had kept their cell phones for periods of between “several hours per day to “eight hours a day or longer.”

Current cellphone models have up to 6 transmitting antennae. For example the iPhone 5 has the 6 antennae: GSM 850 MHz, GSM 1900 MHz, WCDMA Band V, WCDMA Band II, LTE (VOIP) Band 4, and Wi-Fi 2.4 GHz. The women in this case series report have up to 6 primary breast cancers.

Studies of Risk to Male Fertility

There are multiple studies showing deleterious effects on sperm from exposure to cellphone, or laptop computers. In spite of these studies the CTIA Comments ignored the issue.

Human Studies

1. In 2007 a study at the Cleveland Clinic the abstract reported

¹⁸¹ Kaufman et al. Risk factors for leukemia in Thailand. Ann Hematol. 2009 Nov;88(11):1079-88. doi: 10.1007/s00277-009-0731-9. Epub 2009 Mar 18.

¹⁸² A grant from the Mobile Telecommunications and Health Research Programme, which is jointly funded by the UK government and the mobile telecommunication industry.

¹⁸³ Cooke R, Laing S, Swerdlow AJ. A case-control study of risk of leukaemia in relation to mobile phone use. Br J Cancer. 2010 Nov 23;103(11):1729-35.

¹⁸⁴ West et al. Case Report, Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones. Case Rep Med. 2013;2013:354682. doi: 10.1155/2013/354682. Epub 2013 Sep 18.

“Result(s): The comparisons of mean sperm count, motility, viability, and normal morphology among four different cell phone user groups were statistically significant. Mean sperm motility, viability, and normal morphology were significantly different in cell phone user groups within two sperm count groups. The laboratory values of the above four sperm parameters decreased in all four cell phone user groups as the duration of daily exposure to cell phones increased.

Conclusion(s): Use of cell phones decrease the semen quality in men by decreasing the sperm count, motility, viability, and normal morphology. The decrease in sperm parameters was dependent on the duration of daily exposure to cell phones and independent of the initial semen quality.”¹⁸⁵

2. A study show that temperature controlled donor sperm placed 3 cm below a laptop computer connected to Wi-Fi, or in a separate room without a laptop computer or the other electrical devices.¹⁸⁶ The study found
 - a. “Sperm DNA fragmentation was increased after 4 hours of laptop exposure. In the test group, 8.6% \pm 6.6% of the cells were fragmented, whereas only 3.3% \pm 6.0% of the controls showed DNA fragmentation (*P<0.01).”
 - b. “Progressive sperm motility (PG) was significantly reduced in the group incubated under the laptop compared with that of control group (68.7% \pm 8.8% to 80.9% \pm 7.5%, *P<0.01).”
3. A 2010 study examined the effect of cellphone radiation on sperm.¹⁸⁷ It found “Significant reduction in sperm head area (9.2 \pm 0.7 μm^2 vs. 18.8 \pm 1.4 μm^2). The mean number of zona-bound sperm of the test hemizona and controls was 22.8 \pm 12.4 and 31.8 \pm 12.8 (p < 0.05), respectively. This study...had a significant effect on sperm morphometry. In addition, a significant decrease in sperm binding to the hemizona was observed. These results could indicate a significant effect of RF-EMF on sperm fertilization potential.”
4. In 2005 a study reported: “Results: A total of 451 patients were examined during the 13 months of study period. Among the 221 men corresponded the criteria and completed the study, significant correlations were found between duration of standby position and sperm concentration (r=-0.161,

¹⁸⁵ Agarwal et al. Effect of cell phone usage on semen analysis in men attending infertility clinic: an observational study. *Fertil Steril*. 2008 Jan;89(1):124-8. Epub 2007 May 4.

¹⁸⁶ Avendaño et al. Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation. [Fertil Steril](#). 2012 Jan;97(1):39-45.e2. doi: 10.1016/j.fertnstert.2011.10.012. Epub 2011 Nov 23.

¹⁸⁷ Falzone N, Huyser C, Becker P, Leszczynski D, Franken DR (2010) The effect of pulsed 900-MHz GSM mobile phone radiation on the acrosome reaction, head morphometry and zona binding of human spermatozoa. *International Journal of Andrology* 33:1-7.

p=0.04) length of daily transmission and rapid progressive or slow progressive motility ($r=-0.191$, $p=0.005$; $r=0.323$, $p<0.001$, respectively) and between the duration of standby position and rapid progressive motile sperm concentration ($r=-0.218$, $p=0.005$). Furthermore, difference was found between daylong standby and non-standby users in sperm concentration ($59.11 \times 10^6/\text{ml}$ vs $82.97 \times 10^6/\text{ml}$, $p=0.021$, $N=51$ vs 46) and between prolonged transmitters and non-transmitters in rapid progressive motility (36.31% vs 51.34% , $p=0.007$, $N=16$ vs 61).

Conclusions: The prolonged use of cell phones may have negative effect on spermatogenesis and male fertility that presumably deteriorates both concentration and motility.”¹⁸⁸

IARC Monograph 102

This 480 page monograph presented the studies and the reasoning which led to the categorization of radio frequency radiation as a possible carcinogen (Category 2B). In concluding there was “limited evidence” in experimental animals for the carcinogenicity of RF-EMF, the Working Group listed results from all of the animal studies.

The CTIA Comments refers to animal research 9 times emphasizing that the animal data was inadequate. Here we present the animal data reported in Monograph 102:

Animal Studies

1. “An increased incidence of total malignant tumours (all sites) was observed in rats exposed to RF radiation compared with sham-exposed controls (Chou et al., 1992) [p. 259].” The lead author was C-K Chou discussed in the **Credibility of Sources**, Individuals section above.
2. “The authors reported a twofold increase in the incidence of lymphoma in Eu-Pim1 mice exposed to GSM RF radiation ($P = 0.006$ versus the sham exposed group) (Repacholi et al., 1997) [p. 265].” The author was Michael Repacholi discussed in the **Credibility of Sources**, Individuals section above.
3. “The incidences of tumours of the Harderian gland were significantly higher in male mice exposed to RF radiation than in controls, with a dose dependent trend ($P = 0.0028$, one-tailed test); this resulted in a significant positive trend in the overall incidence of benign tumours ($P < 0.01$). For females, no dose-related trends related to exposure to RF radiation were seen

¹⁸⁸ Fejes et al. Is there a relationship between cell phone use and semen quality? Arch Androl. 2005 Sep-Oct;51(5):385-93.

- in the overall incidence of benign or malignant tumours, or of tumours regardless of type (Oberto et al., 2007) [p. 265].”
4. “A more rapid appearance of mammary-gland tumours and a statistically significant increase in the incidence of mammary-gland tumours in both groups of mice exposed to microwave radiation was reported, compared with controls (Szmigielski et al., 1982) [p. 266].”
 5. A study “(Anghileri et al., 2005) [c]ompared with controls, the exposure caused an earlier onset of general lymphocyte infiltration, formation of lymphoblastic ascites, and development of extranodal tumours of different histological types [p. 267].”
 6. In the first of two experiments “the authors reported that mammary gland tumours developed more rapidly in rats exposed to signals at wbSAR 1.4 and 2.2 mW/g compared with controls ... (Anane et al., 2003) [p. 277].”
 7. “When compared with the sham-exposed control group the group at 4.0 mW/g demonstrated a statistically [s]ignificant increase in the number of rats with malignant mammary-gland tumours (mainly adenocarcinomas) and a significant decrease in the number of rats with benign mammary-gland tumours (Hruby et al., 2008) [p. 277].”
 8. “In groups exposed to ENU, UMTS RF radiation increased the incidence of bronchioloalveolar carcinoma and hepatocellular adenoma (Tillmann et al., 2010) [p. 279].”
 9. “Compared with the MX-treated sham-exposed control group [but not the cage control group], a statistically significant increase in the incidence of combined vascular tumours (haemangiomas, haemangiosarcomas and lymphangiomas combined) was observed in the mesenteric lymph nodes of the group treated with MX and RF radiation at a high intensity (wbSAR, 0.9 mW/g). Exposure to RF radiation had no significant effect on the incidence of tumours in any other tissue (Heikkinen et al., 2006) [p. 280].”
 10. “Pre-exposure or simultaneous exposure to microwave radiation at either SAR value accelerated the development of benzo[a]pyrene-induced skin cancer. A comparable acceleration of skin tumorigenesis was reported in benzo[a]pyrenetreated mice undergoing confinement stress for 1 or 3 months (Szmigielski et al., 1982) [p. 280].”
 11. “Two different schedules of exposure to microwave radiation at 2450 MHz were used. ... Irradiation by either schedule resulted in an acceleration in the development of benzo[a]pyrene-induced skin carcinoma and decreased the lifespan of the animals (Szudziński et al., 1982) [p. 280 & 283].”

The above is a selection of studies which found an effect. There were many studies which did not find an effect. However a highly important concept in epidemiology is, “The absence of evidence is not evidence of absence”

Conclusions

The CTIA assertion that there is a 50-fold safety factor is not true. The current “safety” factor is 2.5-fold above a potentially irreversible effect. It would be difficult to understand any public health policy which would set such a “safety” factor so close to an *irreversible injury*, albeit in rats.

CTIA’s assertion that there is a sole FCC approved cellphone certification process is not true. The computer simulation has far greater capability and the FCC should mandate its use in order to protect children, pregnant women and to deal with the reality that children, and women and to a lesser extent men have metal on their bodies, ears, necks, body piercings and dental braces which will all interact with cellphone radiation.

The existing cellphone certification process is fundamentally flawed. There is no confirmation that the single cellphone model provided for certification is representative of production units. The post-market surveillance system is ineffective. If the iPhone 5 dataset provided to the FCC is a typical example, the very credibility of the existing cellphone certification process is in question. An independent auditor should review every step of the cellphone certification process.

CTIA’s asserts there are no non-thermal adverse biological effects from microwave radiation. This is not true. There is a long list of non-thermal effects, as reported in various exposure standards. Perhaps the most important is the repeated findings of radio frequency radiation disruption of calcium homeostasis “which can have important consequences for health.”¹⁸⁹

CTIA asserts that “Current Emission Standards and Testing Procedures are Safe and Appropriate for Children [p. 26].” This is not true. There are studies showing children are at greater risk than adults from exposure to wireless devices, and studies showing children absorb more cellphone microwave radiation than adults.

¹⁸⁹ http://en.wikipedia.org/wiki/Calcium_metabolism (accessed 18 Nov. 2019).

CTIA asserts there are no studies showing risks. This too is not true. There are significant risks from cellphone use for tumors of the brain, the hearing nerve, the cheek's salivary gland, and female breast. There are also multiple studies both in humans and animals showing deleterious effects to sperm including DNA fragmentation.

Our government has a responsibility to protect its citizens and a responsibility to provide data that can help researchers and citizens better understand the health effects from wireless device use:

Per an FCC call for comment [paragraph 215, Notice of Inquiry ET Docket 13-84] to other governmental agencies and institutes for additional information that could help support health research in the U.S., we believe that cellphone use data should be made available anonymously to researchers, and to any customer who requests their personal cellphone call data. Lack of accurate and complete usage data in the U.S. was reported during the House Oversight Committee hearing (Sept. 25, 2008) as one reason why little epidemiological research has been conducted in the U.S. on the potential health effects of exposure to radiofrequency energy from wireless phones. The availability of such anonymized data would also permit the U.S. to participate fully in global epidemiological studies, such as INTERPHONE. The FCC should, when revising its regulations, require that the telecommunications industry maintain such data and make it available in an anonymized form to researchers and to customers upon request.

The FCC's primary obligation is not to optimize profitability for the telecommunications industry. The Commission should enhance communications and protect the most vulnerable members of our society: "infants, the aged, the ill and disabled," [articulated in the IEEE 1991 exposure standard]. As the American Academy of Pediatrics has advised recently advised the Commission, young children should be added to this listed. Fetuses and men who wish to father healthy children should also be included in this "most vulnerable" list.

Throughout the CTIA Comments multiple organizations and individuals are cited to bolster the CTIA's assertion. Many of these organization and individuals have inherent conflicts-of-interests which we have documented above.

Finally, in light of his long history as a lobbyist for industry and as the first President of the Cellular Telecommunication Industry Association, the new Chairman of the FCC, Thomas Wheeler, should recuse himself from any matter

concerning revisions of the exposure limits. Thomas Wheeler's past positions create fundamental conflicts-of-interests.

Appendix, List of Possible Carcinogens

-alpha-C (2-Amino-9H-pyrido[2,3-b]indole)
Acetaldehyde
Acetamide
Acrylonitrile
AF-2 [2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide]
Aflatoxin M1
para-Aminoazobenzen
ortho-Aminoazotoluene
1-Amino-2,4-dibromoanthraquinone
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole
Amsacrine
ortho-Anisidine
Anthraquinone
Antimony trioxide
Aramite®
Auramine
Azaserine
Aziridine
(NB: Overall evaluation upgraded to Group 2B with supporting evidence from other relevant data)
Benz[j]aceanthrylene
(NB: Overall evaluation upgraded to Group 2B with supporting mechanistic and other relevant data)
Benz[a]anthracene
Benzo[b]fluoranthene
Benzo[j]fluoranthene
Benzo[k]fluoranthene
Benzofuran
Benzo[c]phenanthrene
(NB: Overall evaluation upgraded to Group 2B with supporting evidence from other relevant data)
Benzophenone
Benzyl violet 4B
2,2-Bis(bromomethyl)propane-1,3-diol
Bitumens, extracts of steam-refined and air-refined
Bleomycins
(NB: Overall evaluation upgraded to Group 2B with supporting evidence from other relevant data)

Bracken fern
Bromochloroacetic acid
Bromodichloromethane
Butylated hydroxyanisole (BHA)
beta-Butyrolactone
Caffeic acid
Carbon black
Carbon tetrachloride
Carpentry and joinery
Carrageenan, degraded (Poligeenan)
Catechol
Chlordane
Chlordecone (Kepone)
Chlorendic acid
Chlorinated paraffins of average carbon chain length C12
and average degree of chlorination approximately 60%
para-Chloroaniline
3-Chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone
Chloroform
1-Chloro-2-methylpropene
Chlorophenoxy herbicides
4-Chloro-ortho-phenylenediamine
Chloroprene
Chlorothalonil
Chrysene
CI Acid Red 114
CI Basic Red 9
CI Direct Blue 15
Citrus Red No. 2
Cobalt and cobalt compounds
(NB: Evaluated as a group)
Cobalt metal without tungsten carbide
Cobalt sulfate and other soluble cobalt(II) salts
Coconut oil diethanolamine condensate
Coffee (urinary bladder)
(NB: There is some evidence of an inverse relationship
between coffee drinking and cancer of the large bowel;
coffee drinking could not be classified as to its
carcinogenicity to other organs)
para-Cresidine

Cumene
Cycasin
Dacarbazine
Dantron (Chrysazin; 1,8-Dihydroxyanthraquinone)
Daunomycin
DDT (4,4'-Dichlorodiphenyltrichloroethane)
N,N'-Diacetylbenzidine
2,4-Diaminoanisole
4,4'-Diaminodiphenyl ether
2,4-Diaminotoluene
Dibenz[a,h]acridine
Dibenz[a,j]acridine
7H-Dibenzo[c,g]carbazole
Dibenzo[a,h]pyrene
Dibenzo[a,i]pyrene
Dibromoacetic acid
Dibromoacetonitrile
1,2-Dibromo-3-chloropropane
2,3-Dibromopropan-1-ol
Dichloroacetic acid
para-Dichlorobenzene
3,3'-Dichlorobenzidine
3,3'-Dichloro-4,4'-diaminodiphenyl ether
1,2-Dichloroethane
Dichloromethane (Methylene chloride)
1,3-Dichloro-2-propanol
1,3-Dichloropropene (technical-grade)
Dichlorvos
Diesel fuel, marine
(NB: Overall evaluation upgraded to Group 2B with
supporting evidence from other relevant data)
Diethanolamine
Di(2-ethylhexyl)phthalate
1,2-Diethylhydrazine
Diglycidyl resorcinol ether
Dihydrosafrole
Diisopropyl sulfate
3,3'-Dimethoxybenzidine (ortho-Dianisidine)
para-Dimethylaminoazobenzene
trans-2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)-vinyl]-1,3,4-

oxadiazole
2,6-Dimethylaniline (2,6-Xylidine)
Dimethylarsenic acid
3,3'-Dimethylbenzidine (ortho-Tolidine)
1,1-Dimethylhydrazine
3,7-Dinitrofluoranthene
3,9-Dinitrofluoranthene
1,6-Dinitropyrene
1,8-Dinitropyrene
2,4-Dinitrotoluene
2,6-Dinitrotoluene
1,4-Dioxane
Disperse Blue 1
Dry cleaning (occupational exposures in)
Engine exhaust, gasoline
1,2-Epoxybutane
(NB: Overall evaluation upgraded to Group 2B with
supporting evidence from other relevant data)
Ethyl acrylate
Ethylbenzene
Ethyl methanesulfonate
Firefighter (occupational exposure as a)
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole
Fuel oils, residual (heavy)
Fumonisin B1
Furan
Fusarium moniliforme, toxins derived from (fumonisin B1,
fumonisin B2, and fusarin C)
Gasoline
(NB: Overall evaluation upgraded to Group 2B with
supporting evidence from other relevant data)
Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3',2'-
d]imidazole)
Glu-P-2 (2-Aminodipyrido[1,2-a:3',2'-d]imidazole)
Glycidaldehyde
Griseofulvin
HC Blue No. 1
Heptachlor
Hexachlorobenzene
Hexachlorocyclohexanes

Hexachloroethane
2,4-Hexadienal
Hexamethylphosphoramide
Human immunodeficiency virus type 2 (infection with)
Human papillomavirus types 5 and 8 (in patients with
epidermodysplasia verruciformis)
Human papillomavirus types 26, 53, 66, 67, 70, 73, 82
Human papillomavirus types 30, 34, 69, 85, 97
(NB: Classified by phylogenetic analogy to the HPV genus alpha types classified
in Group 1)
Hydrazine
1-Hydroxyanthraquinone
Indeno[1,2,3-cd]pyrene
Iron-dextran complex
Isoprene
Lasiocarpine
Lead
Magenta
Magnetic fields, extremely low-frequency
MeA-alpha-C (2-Amino-3-methyl-9H-pyrido[2,3-b]indole)
Medroxyprogesterone acetate
MeIQ (2-Amino-3,4-dimethylimidazo[4,5-f]quinoline)
MeIQx (2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline)
Merphalan
Methylarsonic acid
2-Methylaziridine (Propyleneimine)
Methylazoxymethanol acetate
5-Methylchrysene
4,4'-Methylene bis(2-methylaniline)
4,4'-Methylenedianiline
Methyleugenol
2-Methylimidazole
4-Methylimidazole
Methyl isobutyl ketone
Methylmercury compounds
(NB: Evaluated as a group)
2-Methyl-1-nitroanthraquinone (uncertain purity)
N-Methyl-N-nitrosourethane
Methylthiouracil
Metronidazole

Michler's base [4,4'-methylenebis(N,N-dimethyl)-benzenamine]
Michler's ketone [4,4'-Bis(dimethylamino)benzophenone]
Microcystin-LR
Mirex
Mitomycin C
Mitoxantrone
3-Monochloro-1,2-propanediol
Monocrotaline
5-(Morpholinomethyl)-3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone
Nafenopin
Naphthalene
Nickel, metallic and alloys
Niridazole
Nitrilotriacetic acid and its salts
(NB: Evaluated as a group)
5-Nitroacenaphthene
2-Nitroanisole
Nitrobenzene
6-Nitrochrysene
Nitrofen (technical-grade)
2-Nitrofluorene
1-[(5-Nitrofurfurylidene)amino]-2-imidazolidinone
N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide
Nitrogen mustard N-oxide
Nitromethane
2-Nitropropane
1-Nitropyrene
4-Nitropyrene
N-Nitrosodi-n-butylamine
N-Nitrosodiethanolamine
N-Nitrosodi-n-propylamine
3-(N-Nitrosomethylamino)propionitrile
N-Nitrosomethylethylamine
N-Nitrosomethylvinylamine
N-Nitrosomorpholine
N-Nitrosopiperidine
N-Nitrosopyrrolidine
N-Nitrososarcosine
Ochratoxin A

Oil Orange SS
Oxazepam
Palygorskite (Attapulgate) (long fibres, > 5 micrometres)
Panfuran S (containing dihydroxymethylfuratrizine)
Pickled vegetables (traditional in Asia)
Phenazopyridine hydrochloride
Phenobarbital
Phenolphthalein
Phenoxybenzamine hydrochloride
Phenyl glycidyl ether
Phenytoin
PhIP (2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine)
Polybrominated biphenyls
Polychlorophenols and their sodium salts (mixed exposures)
Ponceau 3R
Ponceau MX
Potassium bromate
Printing processes (occupational exposures in)
Progestins
Progestogen-only contraceptives
1,3-Propane sultone
beta-Propiolactone
Propylene oxide
Propylthiouracil
Refractory ceramic fibres
Riddelliine
Safrrole
Schistosoma japonicum (infection with)
Sodium ortho-phenylphenate
Special-purpose fibres such as E-glass and '475' glass fibres
Sterigmatocystin
Streptozotocin
Strontium-90 (see Fission products)
Sulfallate
Surgical implants and other foreign bodies:
- Polymeric implants prepared as thin smooth film (with the exception of poly(glycolic acid))
- Metallic implants prepared as thin smooth films
- Implanted foreign bodies of metallic cobalt, metallic nickel and an alloy powder containing 66-67% nickel,

13-16% chromium and 7% iron
Talc-based body powder (perineal use of)
Tetrafluoroethylene
Tetranitromethane
Textile manufacturing industry (work in)
Thioacetamide
4,4'-Thiodianiline
Thiouracil
Titanium dioxide
Toluene diisocyanates
Toxaphene (Polychlorinated camphenes)
Trichlormethine (Trimustine hydrochloride)
Trp-P-1 (3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole)
Trp-P-2 (3-Amino-1-methyl-5H-pyrido[4,3-b]indole)
Trypan blue
Uracil mustard
Vanadium pentoxide
Vinyl acetate
4-Vinylcyclohexene
4-Vinylcyclohexene diepoxide
Welding fumes
(NB: Volume 100D concluded that there is sufficient
evidence for ocular melanoma in welders)
Zalcitabine
Zidovudine (AZT)

"Comments on Notice of Inquiry, ET Docket No. 13-84" GAO Report |
"Exposure and Testing Requirements for Mobile Phones Should Be
Reassessed." Dr. Joel Moskowitz. PhD.; 2012

**Comments on the 2012 GAO Report:
“Exposure and Testing Requirements for Mobile Phones Should Be Reassessed”**

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August 15, 2012 (Aug. 24 revision)

U.S. General Accountability Office (GAO). *Exposure and Testing Requirements for Mobile Phones Should Be Reassessed*. GAO-12-771. Washington, DC: General Accountability Office.
<http://www.gao.gov/products/GAO-12-771> (accessed August 7, 2012)

Overview and General Comments

The GAO Report selectively reviewed scientific literature that supports the FCC's claim that cell phones which comply with the federal standards are safe. The GAO did not consider the methodologic limitations of this research or the alternative interpretations of the results from these studies. The GAO Report did not review the scientific evidence that strongly suggests the FCC standards which control only for thermal effects do not adequately protect the public from harm due to non-thermal effects of long-term exposure to cell phone radiation.

Although we do not have conclusive proof that cell phone radiation is harmful to humans, the FCC certainly cannot prove its claim that cell phones that comply with current federal standards are safe. The claim relies on many assumptions about the science. A critical review of the science—as opposed to simply “weighting the evidence”—reveals that these assumptions have dubious validity.

Evidence of harm from cell phone radiation

The opening statement of the GAO Report is factually incorrect:

"Scientific research has not demonstrated adverse human health effects of exposure to radio-frequency (RF) energy from mobile phone use, but research is ongoing that may increase understanding of any possible effects." (GAO Report, p. 1)

Numerous studies have demonstrated adverse health effects on humans associated with mobile phone use. Case-control research has found evidence for brain tumors (i.e., glioma, meningioma, and acoustic neuroma), and tumors of the parotid gland (Myung et al. 2009; Khurana et al., 2009). Considerable evidence exists for sperm damage caused by exposure to cell phone radiation, and increased male infertility associated with cell phone use (La Vignera et al, 2012). Preliminary evidence exists for reproductive health effects in children following *in utero* exposure to mobile phone radiation (Divan et al., 2008, 2012).

Many researchers with conflicts of interest reject this peer-reviewed research. They even dismiss their own data when the results provide evidence of adverse effects on human health. These researchers often argue that the trends in brain tumor incidence over time have been flat therefore the evidence of harm in these studies must be artifactual. However, many countries are witnessing increased incidence of specific tumors in population subgroups, if not in the overall population, associated with increased exposure over time to microwave radiation from cordless phones in addition to cell phones.

Alternatively, researchers with conflicts of interest typically argue there is no possible biologic mechanism; thus, the adverse health effects observed in their data should be dismissed. This ignores the fact that science commonly discovers causal effects before underlying mechanisms are understood. Nonetheless, numerous experimental studies have demonstrated potential mechanisms in animal models and cellular

studies caused by acute, non-thermal exposures to microwave radiation. The evidence includes penetration of the blood-brain barrier, generation of free radicals and heat shock proteins, single- and double-strand DNA damage, as well as sperm damage. Multiple peer-reviewed laboratory studies demonstrate each of these adverse effects (e.g., Behari, 2010). Recently, Volkow et al. (2011) demonstrated increased glucose metabolism in human brains after a brief (non-thermal) exposure to cell phone radiation.

The little research conducted on children and pregnant women suggests these two populations are at greatest risk of harm from cell phone radiation. The GAO report does not cite the work of Om Gandhi which finds that the child's brain absorbs much more microwave radiation than the adult's brain (Gandhi et al., 2012). According to Reardon (2011) "Several countries, including Russia, Germany, France, Israel, Finland, and the United Kingdom, have issued warnings against children using cell phones." Yet, the GAO Report does not discuss children's safety from cell phone radiation even though most children in the U.S. currently have cell phones.

FCC cell phone radiation standards

The history of cell phone radiation standard setting in the U.S. reveals the FCC's inability to oversee a process that ensures decision making free of conflict of interest. The FCC does not have the expertise to oversee the research needed to develop prudent standards.

In 1978, the U.S. Comptroller General (1978) issued a report to the Congress which recommended the potential need to regulate non-thermal effects of microwave radiation based upon a review of the research conducted by the FDA. However, 18 years later in 1996, when the FCC adopted the federal cell phone radiation standards, the Commission enacted standards that controlled only for the thermal effects of the microwave radiation emitted by mobile phones. The FCC adopted standards developed by two industry groups, first by IEEE in 1991 and subsequently by ANSI. These standard setting meetings were heavily dominated by engineers and physical scientists, not health scientists. At the time, the EPA was conducting research on microwave radiation and had found evidence of non-thermal effects; however, in early 1996, their funding for this research was terminated by the Congress. In 2004, the FCC issued a public request for input on some cell phone regulatory standards; however, eight years later the agency has yet to act upon this. Hence, the FCC still employs the standards developed 21 years ago when hardly anyone used cell phones even though almost all adults and most children now use this technology.

The Radiofrequency Interagency Working Group that advises the FCC on radiation-emitting consumer products including cell phones has been a failure. This arrangement diffuses responsibility which enables the participating agencies to point fingers at each other leading to inaction according to the GAO Report:

"According to senior FCC officials, the agency has not adopted any newer limit because federal health and safety agencies have not advised them to do so. FCC officials told us that they rely heavily on the guidance and recommendations of federal health and safety agencies when determining the appropriate RF energy exposure limit and that, to date, none of these agencies have advised FCC that its current RF energy limit needs to be revised. Officials from FDA and EPA told us that FCC has not formally asked either agency for an opinion on the RF energy limit. FDA officials noted, though, that if they had a concern with the current RF energy exposure limit, then they would bring it to the attention of FCC." (GAO Report, p. 18)

Given these historic failures, the FCC should not be trusted to oversee another review of the cell phone radiation standards. Most industry-funded scientists, as well as some government scientists, deny there is any risk from chronic non-thermal exposures to cell phone radiation. If the FCC oversees a review of the standards, the agency is likely to rely heavily on the IEEE once again and adopt regulations based only on thermal effects. Moreover, since 2006, the IEEE has been advocating that the U.S. adopt standards set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The GAO Report notes that more than 40 countries have adopted the weaker ICNIRP Specific Absorption Rate (SAR) standard, a measure of the amount of energy absorbed from a cell phone in a simulated head. The Report does not mention that six countries have adopted the U.S. SAR standard (Australia, Bolivia, Canada, New Zealand, South Korea, and recently, India). Nor does the Report mention that Russia, a

country that has conducted much of the health effects research on exposure to non-thermal levels of microwave radiation, has more stringent cell phone emission standards than the U.S.

Although the ICNIRP maximum specific absorption rate (SAR) of 2.0 watts per kilogram averaged over 10 grams of tissue does not sound very different from the U.S. maximum SAR of 1.6 watts per kilogram averaged over 1 gram of tissue, it actually represents a substantial difference because averaging heat absorption over a larger volume of tissue averages out the "hot spots":

"A mobile phone compliant with the ICNIRP standard of 2.0 W/kg SAR in 10 g of tissue may lead to a 2.5 to 3 times excess above the FCC standard of 1.6 W/kg in 1 g of tissue (i.e., 4–5 W/kg in a cube of 1 g of tissue)" (Gandhi and Kang, 2002)." (cited in Gandhi et al, 2012)

"James Lin of the University of Illinois, Chicago, who was recently appointed a member of ICNIRP, has called this proposal to increase the averaging volume from 1g to 10g 'scientifically indefensible' (see MWN, J/A00 and N/D00). According to Lin, a limit of 2.0 W/Kg averaged over 10g would be approximately equivalent to an SAR of 4-6 W/Kg, averaged over 1g (see MWN, S/O01 and M/J03). Or to put it more simply, ICES wants to triple the amount of radiation you could get from a cell phone." (Slesin, 2005)

Federal government negligent in funding cell phone radiation research

Although more research is needed to determine the long-term health consequences from continued exposure to non-thermal levels of cell phone radiation, little of this research is being conducted in the U.S. Nor are we conducting the research needed to develop safer standards and safer cell phone technology.

For the past 16 years, our federal health agencies have been negligent in funding research on the health effects of exposure to microwave radiation. The U.S. has also failed to participate in major international studies (e.g., Interphone, CEFALO, MOBI-KIDS, and COSMOS). The federal government has largely relied on industry to fund and conduct the research. From 1994-1999, the CTIA, the major wireless industry association, funded the Wireless Technology Research (WTR) Program, a \$25 million research initiative. In 2000, the CTIA funded a new research initiative, CRADA that was supposed to include FDA participation but did not. The intent of this initiative was to follow up on two studies that found harmful effects from low levels of cell phone radiation in the WTR program. Little research was published in the peer-reviewed literature from either of these industry-sponsored research programs.

The largest ongoing federally-funded study of exposure to cell phone radiation examines the health effects of 2G (i.e., second generation) cell phone technologies (GSM, CDMA) on mice and rats. The findings will be obsolete soon after the study is completed in 2015 because the industry is phasing out 2G. We should be conducting research on the health effects of 3G and 4G at this time. Some research suggests that DNA damage occurs at much lower exposures to 3G radiation than 2G. No health effects research has been published on 4G to date.

"According to representatives from the Mobile Manufacturers Forum, the association has provided about \$46 million for RF energy research since 2000 and is currently providing support for epidemiological and laboratory studies." (GAO Report, p. 16)

A major reason for the conflicting evidence about the health effects of cell phone radiation after more than two decades of research is because governments and the W.H.O. have relied on industry to fund all or part of the research. *Microwave News* has documented several incidents where industry-funded researchers lost their funding after reporting evidence of biologic activity in laboratory studies or harmful effects in humans. The corrupting influence of industry on the scientific community and on the health effects and biologic research has been chronicled for several decades by Louis Slesin in his newsletter, *Microwave News* (<http://microwavenews.com>), and was summarized by Devra Davis in her recent book, *Disconnect* (Davis, 2010).

If we hope to develop a body of high quality research that policy makers can rely upon, we must cultivate a scientific community that is independent of industry. A fee of fifty cents per year, or a penny per week,

assessed on each cell phone in the U.S. could generate \$150 million annually for research and education about cell phones and other forms of electromagnetic radiation.

GAO Report recommendations

The GAO Report makes two recommendations:

“We recommend that the Chairman of the FCC take the following two actions:

- Formally reassess the current RF energy exposure limit, including its effects on human health, the costs and benefits associated with keeping the current limit, and the opinions of relevant health and safety agencies, and change the limit if determined appropriate.
- Reassess whether mobile phone testing requirements result in the identification of maximum RF energy exposure in likely usage configurations, particularly when mobile phones are held against the body, and update testing requirements as appropriate.” (GAO Report, p. 28)

The GAO Report indicates that the industry and its affiliated organizations want the FCC to weaken the current standards by adopting the more permissive ICNIRP standards. In contrast, national environmental health organizations, which the Report refers to as “consumer groups,” demand that the FCC standards be strengthened, and the testing conditions be re-designed to better simulate real-world use of cell phones to ensure public safety.

Some environmental health groups and many scientists want supplemental standards developed to control for additional characteristics of cell phone radiation besides energy absorption (as measured by the SAR). These signal characteristics (frequency, modulation, etc.) are biologically active through non-thermal mechanisms. Considerable evidence exists that these non-thermal effects cause harm to human health as well as the health of other species (Fragopoulou et al., 2010; Juutilainen et al., 2011; Gandhi et al., 2012; Blank and Goodman, 2012). Cell phone regulatory standards should be designed to minimize these deleterious effects.

Based upon the FCC’s track record over the past several decades, the Congress should seriously consider assigning these tasks to a health agency with the requisite expertise and fund that agency to oversee the research and development of safety standards that ensure the protection of population health from **non-thermal** in addition to thermal risks associated with exposure to cell phone radiation.

The GAO Report’s second recommendation addresses a major deficiency in the FCC guidelines with regard to certification of cell phone safety. The FCC has failed to enforce its guideline that requires testing of cell phones in the manner in which they are used, namely, “against the ear and against the body.” Because the FCC allows cell phones to be tested from 1.5 to 2.5 cm (5/8 – 1 inch) away from the body and most users do not keep their phones this distance from their bodies, cell phones are being used unsafely much of the time based on the FCC’s safety definition. More importantly, users increase their risk of harm from microwave radiation by not using their phones the way they were tested.

The Report should also recommend to the FCC that its cell phone certification process employ artificial models, known as specific anthropomorphic mannequins, that resemble today’s cell phone users. The head of the mannequin in current use is modeled after an adult male in the 90th percentile of the military. People with smaller heads than the mannequin which includes most of the population absorb more radiation than the current test measures. Thus, most people are exposed to more microwave radiation from their cell phone than the FCC deems safe based on the current SAR standard.

The cell phone certification process should simulate who uses cell phones today including children, teenagers, pregnant women, males and females of reproductive age, seniors, and individuals with compromised immune systems and those who wear metal eyeglass frames or have metal fillings or braces on their teeth. The process should also simulate how cell phones are commonly used (e.g., directly against the head and body, in moving vehicles and in elevators).

Specific Comments

GAO Report:

“this report addresses (1) what is known about the health effects of RF energy from mobile phones and what are current research activities, (2) how FCC set the RF energy exposure limit for mobile phones, and (3) federal agency and industry actions to inform the public about health issues related to mobile phones, among other things.”

“FDA stated that while the overall body of research has not demonstrated adverse health effects, some individual studies suggest possible effects. Officials from NIH, experts we interviewed, and a working group commissioned by IARC—the World Health Organization’s agency that promotes international collaboration in cancer research—have reached similar conclusions. For example, in May 2011 IARC classified RF energy as “possibly IARC determined that the evidence from the scientific research for gliomas, a type of cancerous brain tumor, was limited—meaning that an association has been observed between RF energy exposure and cancer for which a causal relationship is considered to be credible, but chance, bias, or confounding factors could not be ruled out with reasonable confidence.” (GAO Report, pp. 6-7)

“Studies we reviewed suggested and experts we interviewed stated that epidemiological research has not demonstrated adverse health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have suggested a possible association with certain types of tumors, including cancerous tumors.” (GAO Report, p. 8)

Comment: Our research group published a review of the case-control research on mobile phone use and tumor risk in humans in the *Journal of Clinical Oncology* in 2009 that received worldwide attention (Myung et al, 2009a). **Our primary conclusion was that it is misleading to examine the overall weight of the evidence. Rather one must sort the studies based on research quality to see the true picture.**

Case-control studies that employed high quality research methods demonstrated a significant positive association between mobile phone use and tumor risk (i.e., increased risk). This association was stronger for brain tumors among those who used cell phones for 10 or more years, especially on the side of the head where the phone was held. In contrast, low quality studies displayed a significant negative association between mobile phone use and tumor risk (i.e., reduced risk or a protective effect from using cell phones). Thus, when we combined the estimates of tumor risk from the high and low quality studies, we found no overall risk. Many scientists in academia and government have focused on the overall weight of the evidence and have ignored the quality of the research. This is how they conclude we do not have adequate evidence. We also found that low quality studies tended to be funded all or in part by industry. Even the W.H.O. Interphone Study received one-fourth of its funding from industry. In contrast, high quality studies were more likely to be funded by government health agencies. Thus, conflicts of interest may have played a key role in the conduct and reporting of the research (Myung et al., 2009b). These conclusions are reinforced by studies that were completed since our review paper was published.

“we recommend that research on the topic of mobile phone use and health should not be funded by the industry because funding sources can influence research in subtle ways, and to preserve the credibility of the research it is important to avoid even the appearance of a conflict of interest.” (Myung et al, 2009b)

GAO Report:

“findings from a nationwide cohort study conducted in Denmark that originally followed 420,095 individuals did not show an association between increased risk for certain types of tumors, including cancerous tumors, and mobile phone use. Additionally, findings from a subset of the cohort—56,648 individuals with 10 or more years since their first mobile phone subscription—did not show an increased risk for brain and nervous system tumors. Further, these findings did not

change for individuals in the cohort with 13 or more years since their first mobile phone subscription. (GAO Report, pp.8-9)

Comment: In our review of the literature, we dismissed the results of the Danish Cohort study because we believed that serious methodologic problems rendered the results uninterpretable (Myung et al, 2009a). The study has been criticized because it was biased against finding increased tumor risk. Many of its results found what appeared to be reduced risk (i.e., a protective effect from using cell phones). That most of the heaviest cell phone users whose phones belonged to their businesses were classified as non-cell phone users biased the results against finding increased risk (Slesin, 2011).

"The Danish study has another, perhaps even more potentially fatal source of bias. The user population includes only those who had a cell phone in 1995—that was about 20% of the population. The Danish Cancer Society treats everyone who took up cell phones after 1995 as if they had never used one. They too are in the control group. That's hard to believe but true. Here's a direct quote from the BMJ paper: 'individuals with a subscription in 1996 or later were classified as non-users.'" (Slesin, 2011).

GAO Report:

"Also, the CEFALO study—an international case-control study that compared children aged 7 to 19 diagnosed with certain types of brain tumors, including brain cancers, to similar children who were not diagnosed with brain tumors—found no relationship between mobile phone use and risk for brain tumors." (GAO Report, p. 9)

Comment: Contrary to the study authors' conclusions and the GAO's summary, the CEFALO study reported significantly increased brain tumor risk among children who used cell phones in several analyses despite small amounts of cell phone use and short duration of use. See the Soderqvist et al (2011) for a full critique of this study and alternative interpretations of the results.

GAO Report:

"Findings from another study, which was conducted by NIH and examined trends in brain cancer incidence rates in the United States using national cancer registry data collected from 1992 to 2006, did not find an increase in new cases of brain cancer, despite a dramatic increase in mobile phone use during this time period." (GAO Report, p. 9)

Comment:

Although this study did not find an overall increase in brain cancer incidence, it did report an increase for young adults 20-29 years of age (Inskip et al., 2010). Young adults are likely to be more vulnerable to microwave radiation because their brains are not fully developed. The authors of the study dismissed this result because the tumors were located in the frontal lobe, and because the increased cancer incidence in men started before cell phones were popular in the U.S. However, absorption of microwave radiation is substantial in this lobe, and frontal lobe tumors have been associated with mobile phone use in case-control studies. Also, cordless phones which were popular before cell phones emit microwave radiation so these phones may have contributed to the increased tumor incidence observed in young adults.

GAO Report:

"Studies we reviewed suggested and experts we interviewed stated that laboratory research has not demonstrated adverse human health effects from RF energy exposure from mobile phone use, but the research is not conclusive because findings from some studies have observed

effects on test subjects.... According to some studies we reviewed, while some of these studies have observed changes in behavior and cognitive function, overall, these studies have not consistently found adverse effects from RF energy levels emitted from mobile phones.” (GAO Report, p. 10)

Comment: Just as we found evidence for conflict of interest affecting the epidemiologic research, Dr. Henry Lai has reported possible evidence of conflict of interest with the toxicology research:

“Henry Lai, a research professor in the bioengineering department at the University of Washington, began laboratory radiation studies in 1980 and found that rats exposed to radiofrequency radiation had damaged brain DNA. He maintains a database that holds 400 scientific papers on possible biological effects of radiation from wireless communication. He found that 28 percent of studies with cellphone industry funding showed some sort of effect, while 67 percent of studies without such funding did so. “That’s not trivial,” he said.” (Randall Stross. Should you be snuggling with your cellphone? New York Times, Nov 13, 2010. URL: <http://www.nytimes.com/2010/11/14/business/14digi.html>)

An in-depth discussion of conflict of interest associated with research funding from the mobile phone industry and the U.S. Air Force can be found in Microwave News (Slesin, 2006).

GAO Report:

“Studies we reviewed and experts we interviewed identified key areas for additional epidemiological and laboratory studies, and according to experts, additional research may increase understanding of any possible effects. For example, additional epidemiological studies, particularly large long-term prospective cohort studies and case-control studies on children, could increase knowledge on potential risks of cancer from mobile phone use.” (GAO Report, p. 12)

Comment: In our review paper, we recommended long-term prospective cohort studies as this research could yield stronger empirical evidence than case-control study research (Myung et al., 2009a). However, we no longer recommend this for the following reasons: (1) Given the widespread adoption and use of cell phones it would be difficult to recruit enough individuals for the cohort who are not exposed to cell phone, cordless phone or Wi-Fi radiation, and variation over time in microwave radiation exposure levels are necessary to detect effects on tumor risk; (2) the research would be very costly and difficult to conduct as extremely large samples of participants would be needed due to the low incidence of brain tumors; and (3) the results would not be available for 20-30 years since the latency between exposure to cell phone radiation and tumor detection can be up to four decades; meanwhile, cell phone technology keeps changing so the results may have limited value when they are published.

GAO Report:

“additional studies on laboratory animals as well as human and animal cells examining the possible toxic or harmful effects of RF energy exposure could increase knowledge on potential biological and health effects of RF energy. Further, additional laboratory studies on human and animal cells to examine non-thermal effects of RF energy could increase knowledge of how, if at all, RF energy interacts with biological systems. However, some experts we spoke to noted that, absent clear evidence for adverse health effects, it is difficult to justify investing significant resources in research examining non-thermal effects of RF energy from mobile phone use.” (GAO Report, p. 12)

Comment: Although results are not consistent, numerous peer-reviewed toxicology studies demonstrate evidence for non-thermal effects of RF energy from mobile phone use, especially for GSM and UMTS mobile phone carrier systems (Juutilainen et al., 2011; Wolchover, 2011). Fewer studies have been conducted on CDMA and W-CDMA mobile carrier systems, and there is less evidence for biologic activity for these technologies. The lack of research on CDMA and W-CDMA can be explained by two factors: (1)

Most research on the health effects of cell phone radiation has been conducted outside of the U.S. because our federal government has neglected to fund this research with minor exceptions; and (2) few countries other than the U.S. employ CDMA and W-CDMA (currently used by half of the U.S. population who have Verizon and Sprint as their cell phone providers); hence, few countries fund research on these two technologies.

The U.S. has one major study in progress that contrasts the effects of GSM and CDMA in mice and rats conducted by the National Toxicology Program. Results from this study should be available by 2015. However, these 2G (second generation) technologies are likely to be obsolete in the U.S. by 2016. We need a major research funding initiative now to evaluate the effects of 3G (UMTS, W-CDMA) and 4G (LTE, WiMax) technologies and to enable us to set appropriate regulatory standards for these forms of microwave radiation to protect population health.

GAO Report:

"The Danish National Birth Cohort consists of over 100,000 Danish children who were born from 1996 to 2002. Data on lifestyle factors, dietary habits, and environmental exposures have been collected on these children, and data on current mobile phone use by children have been collected since these children reached the age of seven." (GAO Report, Footnote b, p. 14)

Comment: The only mention of this study in the Report appears in a footnote even though Dr. Leeka Kheifets at UCLA was one of the experts the GAO consulted. Moreover, her study is one of a few cell phone radiation health effect studies that the federal government has funded. Dr. Kheifets has published two peer-reviewed papers that reported behavioral problems in children exposed *in utero* to cell phone radiation (Divan et al., 2008, 2012). These children were more likely to display symptoms that resemble attention deficit disorder. If these reproductive health effects are replicable, they have profound implications for public health. Recently, Dr. Hugh Taylor at Yale replicated these behavioral effects in an experimental study conducted with rats exposed to cell phone radiation *in utero* (Aldad et al., 2012).

GAO Report:

"In 1996, FCC adopted the RF energy exposure limit for mobile phones of 1.6 watts per kilogram, averaged over one gram of tissue, a measurement of the amount of RF energy absorbed into the body.²⁸ FCC developed its limit based on input from federal health and safety agencies as well as the 1991 recommendation by the Institute of Electrical and Electronics Engineers (IEEE) that was subsequently approved and issued in 1992 by the American National Standards Institute (ANSI). This recommended limit was based on evidence related to the thermal effects—the only proven health effects of RF energy exposure—and was set at a level well below the threshold for such effects. FCC noted that the limit provided a proper balance between protecting the public from exposure to potentially harmful RF energy and allowing industry to provide telecommunications services to the public in the most efficient and practical manner possible." (GAO Report, pp. 16-17)

Comment: In 1996, the FCC based its cell phone radiation standard on a set of recommendations made by two industry groups composed largely of engineers. The exposure limit protects the user from the acute effects from heating of body tissue but not from the non-thermal effects of microwave radiation. The FCC claimed that the SAR limit it adopted was based on input from federal health and safety agencies yet it ignored the EPA's recommendation at the time that the SAR be limited to 1.0 watts per kilogram instead of 1.6 watts per kilogram. Instead, the FCC traded public safety for the industry's recommendation to achieve what it considered "a proper balance."

"The EPA and NIOSH, two health agencies that have studied the RF/MW health data for decades, have each advocated pegging the threshold to 1 W/Kg for the public and to 2 W/Kg for workers, respectively." (Slesin, 19966)

GAO Report:

"FCC has implemented standardized testing procedures requiring mobile phones to be tested for compliance with the RF energy exposure limit when in use against the ear and against the body while in body-worn accessories, such as holsters, but these requirements may not identify the maximum exposure under other conditions. The specific minimum separation distance from the body is determined by the manufacturer (never to exceed 2.5 centimeters), based on the way in which the mobile phone is designed to be used. FCC has not reassessed its testing requirements to ensure that testing identifies the maximum RF energy exposure for the other usage conditions a user could experience when mobile phones are in use without body-worn accessories or as advised by the manufacturer's instructions, rather than the head." (GAO Report, pp. 22-23)

Comment: The FCC should not have allowed manufacturers the latitude to decide whether to test the phone from 1.5 to 2.5 centimeters from the body in the "against the body" test. Because these distances are in the "near-field" of the antenna each additional millimeter corresponds to a 15% reduction in emissions. A phone tested at 2.5 cm can produce up to 5 times the microwave radiation as a phone tested at 1.5 cm and still be legal. Furthermore, the "against the body" SARs are not comparable for two phones tested at different distances from the body.

According to the FCC 2001 guidelines, the manufacturer can use warning labels to ensure that the user maintains a minimum distance between his body and the phone that corresponds to the distance used in the SAR test procedure. However, if the manufacturer, cannot ensure that the user will comply with this instruction, then the SAR test must be conducted "at its closest range to persons under normal operating conditions."

"When applicable, operation instructions and prominent warning labels may be used to alert the exposed persons to maintain a specified distance from the transmitter or to limit their exposure durations and usage conditions to ensure compliance. If the use of warning labels on a transmitter is not effective or desirable, the alternative of performing SAR evaluation with the device at its closest range to persons under normal operating conditions may be used." (FCC, 2001, p. 8)

GAO Report:

"Representatives from some consumer groups and experts we spoke with raised concerns that the information on federal agency websites about mobile phone health effects is not precautionary enough, among other things. In particular, these representatives and experts said that federal agencies should include stronger precautionary information about mobile phones because of the uncertain state of scientific research on mobile phone health effects as well as the fact that current testing requirements may not identify the maximum possible RF energy exposure." (GAO Report, p. 25)

Comment: Information on federal agency websites about mobile phones is at best confusing, and often misleading. Coverage of the health effects research has often been biased. For example, news coverage of the major Interphone Study paper reported "no evidence" of increased tumor risk on both the FDA and the NCI web sites (e.g., "No Evidence Linking Cell Phone Use to Risk of Brain Tumors," FDA Consumer Health Information; May 17, 2010). This was completely false as a significant 40% increased glioma risk was found for the heaviest cell phone users (which corresponded to about 30 minutes per day over 10 years) (Interphone Study Group, 2010a). Appendix 2 of this paper presented results from analyses that corrected for selection bias in the study (Interphone Study Group, 2010b). In the appendix, the heaviest cell phone users had 82% increased risk of glioma as compared to those who used cell phones less than 5 hours in their lifetime. Moreover, a significant dose-response relationship for number of years of cell phone use and glioma risk was reported. Based upon the results of this study, two of the investigators including the lead investigator have called for precautionary health warnings to "reduce exposure to the brain from mobile phones...particularly among young people" (Cardis and Sadetzki, 2011).

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Organizations; Consumers for Safe Cell
Phones Comments (Petitioner), Sep. 2, 2013

FCC 13-39

**Before the
Federal Communications
Commission Washington, D.C.
20554**

In the Matter of)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure Limits and)	
Policies)	
)	

To: Office of the Secretary
Federal Communications Commission

Comments Submitted By:

Consumers for Safe Cell Phones
Cynthia Franklin, President
520 Ridgeway Drive
Bellingham, WA 98225

Consumers for Safe Cell Phones is a 501C3 non-profit organization. I, Cynthia Franklin, attest that my statements are true to the best of my knowledge.

JA 07616

IV. Further Notice of Proposed Rule Making

109. With respect to striking a balance between protecting the public and enabling the industry to provide communication services to US citizens, Consumers for Safe Cell Phones (CSCP) comments as follows:

The FCC is mandated to protect citizens from the known hazards of microwave radiation exposure. Nowhere is it stated that the FCC's function is to facilitate the telecom industry's profit-making potential. And, nowhere is it stated that FCC's function is to ensure citizens have unlimited access to wireless internet connection in their homes, public spaces, schools, public transportation to allow them to send photos, access email, connect on Facebook and download sports games and movies at all hours of the day and night. The LEGAL balance to be considered is between the risks to public health from microwave radiation exposure and ensuring a uniform, efficient, reliable communications network of services designed to ensure the safety and welfare of the American people. We implore the Commission to be clear about exactly what your role is in this balance as you weigh the costs and benefits to all the issues being considered herein.

114. CSCP supports this proposed modification: “.....considering both total ERP and separation distance, rather than height above ground, to determine whether a routine evaluation is necessary. Separation distance....defined as the minimum distance from the radiating structure of the transmitting antennae in any direction to any area that is accessible to a worker or to a member of the general public.”

134. CSCP supports the statement, “.....and a simple set of criteria.....will help ensure understanding and compliance with our regulations.” Not only will this simplify the application process, but it will also allow consumers and health advocacy groups to make sense of the regulations that are currently unnecessarily complicated and confusing.

172. CSCP supports the proposal to remove the 5 cm. minimum distance for compliance testing in order to simulate SAR in typical RF exposure situations.

175. Mitigation – There is great concern with respect to crowds where citizens are exposed to WIFI and/or cellular transmissions at undetermined and essentially unknown exposure levels. At present, the FCC guidelines do not take into account the exposure that citizens receive in these situations from the many surrounding smartphones, laptops, tablets and personal “hot spots” transmitting simultaneously in close proximity to their heads and bodies. Three situations in which this is of major concern are:

1. Public transportation (planes, trains, buses) in which many passengers are unknowingly exposed to potentially high levels of WIFI and the RF energy

from their and the other passengers' transmitting devices within the confines of typically metal enclosures with highly reflective surfaces.

2. Classrooms are of great concern as it is typical that children are continuously exposed for many hours throughout the day to multiple, undetermined sources of WIFI transmission in the building in addition to the many WIFI-enabled laptops, smartphones and other devices simultaneously transmitting in close proximity to children's developing brains and bodies.
3. There is also concern regarding the use of the temporary towers or "cows" that are installed on trucks to transmit AT UNDETERMINED, UNMONITORED LEVELS into public gatherings.

It is unacceptable that the FCC has failed to properly account for these typical exposure situations in which the public is exposed to undetermined and unmonitored levels of microwave radiation. Until the FCC has promulgated rules to require testing for these and similar scenarios, mitigation procedures must be put in place. It is imperative in these situations that handouts, signs or posters be made available to educate and inform citizens that levels may exceed the FCC exposure guidelines and about ways exposure can be reduced for those who are concerned.

The FCC must establish procedures to estimate the accumulated exposure a citizen may receive in these types of situations, especially with respect to the children and the fetuses of pregnant women whose developing brains and nervous systems are proven to be more vulnerable to exposure from microwave radiation.

190. In exposure situations where the general population limit is possibly exceeded, the sign **MUST** provide up to date contact information. This should not be optional as it would be unlikely to be provided if there is a choice.

200. CSCP supports inclusion of requiring contact information, i.e.; "phone number or email address resulting in a timely response." This information is important to be included in order to reduce the public's concerns about a particular exposure location, especially if it is in close proximity to a school, residence, park or other public space. Citizens need to have exposure information available if they have questions or concerns that they feel need to be addressed. Also, FCC needs to be more responsive in responding to consumer complaints about possible overexposure situations.

V. Notice of Inquiry

209. With respect to striking a balance between protecting the public and enabling the industry to provide communication services to US citizens, Consumers for Safe Cell Phones (CSCP) comments as follows:

The FCC is mandated to protect citizens from the known hazards of microwave radiation exposure. Nowhere is it stated that the FCC's function is to facilitate the telecom industry's profit-making potential. And, nowhere is it stated that FCC's function is to ensure that citizens have unlimited access to wireless internet connection in their homes, public spaces, schools and on public transportation to allow them to send photos, access email, connect on Facebook and download sports games and movies at all hours of the day and night. The LEGAL balance to be considered is between the risks to public health from microwave radiation exposure and providing a uniform, efficient, reliable communications network of services designed to ensure the safety and welfare of the American people. We implore the Commission to be clear about exactly what your role is in striking this balance as you weigh the costs and benefits to all the issues being considered in these proceedings.

It is important for the FCC to consider that it is NOT mandated that the communications network be WIRELESS. Considering that this form of communication relies upon an exposure that is now classified as an IARC 2B carcinogen, it is time to require a NON-WIRELESS infrastructure – there is no way to justify the risk to public health from continuous AND INCREASING exposure to greater and higher frequencies of pulsed, microwave radiation.

The balance has shifted away from protection of the health of the American people and is GROSSLY in favor of the economic interests of the telecom industry. We, the people, are being exposed to frequencies and intensities of microwave radiation that have never been tested on humans. It is frightening and unacceptable for this situation to continue.

219. In response to the question, “we specifically seek comment as to whether our current limits are appropriate as they relate to device use by children. CSCP has the following comment on this topic:

The current compliance testing procedure uses the SAM model which, being based upon a 220 pound, 6'2" man, only takes into account the SAR levels for the largest 3% of the U.S. population. Children, teens and smaller adults are NOT taken into account. No, FCC's current limits are NOT appropriate as they relate to use by children; device manufacturers are blatantly marketing to parents of toddlers and babies encouraging them to buy devices and apps designed to be held in close proximity to (and directly against) their children's heads and bodies.

223. The concept of “behavior-based time averaging” is confusing. For consumer devices, we urge the FCC to require a testing/evaluation method that most accurately simulates the typical use scenario. For cell phones, this requires no separation distance when simulating use at the torso as the typical consumer makes calls (or receives calls, texts, emails notifications, etc.) with the back of the phone flush against the skin (as when carried in a bra or waistband) or with very little fabric separation.

224. Given the growing evidence of biological effects at non-thermal levels, CSCP strongly urges consideration of studies showing DNA damage as well as negative neurological and cardiovascular effects from exposure at levels hundreds and even thousands of times below the current standard.

In particular, we are noticing increasing health complaints from citizens who live in close proximity to “smart” meters that send out relatively high bursts of RF energy as often as multiple times per minute. This type of exposure is NOT currently taken into account by existing FCC standards.

The FCC must adopt rules to adequately regulate the exposure from “smart” meters as these RF emitting devices are exposing thousands, if not millions of citizens to essentially unknown, untested levels of microwave radiation, in many cases, against a citizen’s knowledge or approval.

It is unacceptable that the FCC has allowed these microwave-emitting devices to be installed on our homes without consideration of long-term studies showing potential health risks at non-thermal exposure levels.

As early as 1999, the FCC accepted that biological effects were shown to occur at non-thermal levels as referenced in this early version of OET Bulletin 56:

*OET BULLETIN 56
Fourth Edition
August 1999*

*Questions and Answers about Biological Effects and Potential Hazards of
Radiofrequency Electromagnetic Fields*

WHAT BIOLOGICAL EFFECTS CAN BE CAUSED BY RF ENERGY?

*“More recently, other scientific laboratories in North America, Europe and elsewhere have reported **certain biological effects after exposure of animals ("in vivo") and animal tissue ("in vitro") to relatively low levels of RF radiation. These reported effects have included certain changes in the immune system, neurological effects, behavioral effects, evidence for a link between microwave exposure and the action of certain drugs and compounds, a "calcium efflux" effect in brain tissue (exposed under very specific***

conditions), and effects on DNA.” (pg 8)

And, now, 14 years later, the FCC is “pretending” that non-thermal effects do not exist.

There was convincing evidence in 1999 when past FCC staff admitted the possibility – and the evidence is more conclusive today, in spite of the unwillingness of the IEEE and ICNIRP to admit the likelihood that this is in fact true.

The FCC MUST re-evaluate their exposure standards and take into account the documented biological effects from non-thermal levels of microwave radiation.

231. The consumer information found on the FCC’s website has improved over the past 2 years, but it still fails to inform users to never wear or use a cell phone in a pocket or directly against the body as when tucked into a bra or waistband. This intentional omission is unacceptable as the FCC is aware that the testing separation must be maintained in order to ensure that consumers are not exposed to RF energy that may exceed the limit. There appears to be collusion between FCC staff and the cell phone industry to keep consumers in the dark about this vital safe use information.

Top-level FCC staff have said that it doesn’t really matter about maintaining the separation distance as there is a 50-fold safety factor built into the standard. It is inappropriate for FCC staff to make policy decisions based upon an opinion that fifty times below a relatively high level of tissue heating (i.e.; a SAR of 4 W/kg) is adequate to protect citizens from the known hazards of microwave radiation exposure.....especially given the growing body of peer-reviewed studies showing health effects at hundreds and even thousands of times below the current standard.

The FCC consumer website MUST provide factual and complete information to the public, and until the separation distance “warning” is included on the website in a prominent location, the website is incomplete and misleading as it allows consumers to believe that it is safe and compliant to carry and use a cell phone directly against the body.

233. Cell phone manufacturers (with tacit approval by top level CTIA officials) engage in the industry-wide practice of deceptively hiding the separation distance “warning” in the legal fine print of user manuals in obscure locations that are not likely to be seen by users. When local jurisdictions have attempted to inform citizens of this and other important safe use information about cell phones, the industry has launched aggressive legal campaigns to intimidate lawmakers to either reject or repeal “right to know” laws.

This is occurring in conjunction with Apple deciding to remove any mention of the

separation distance “warning” from their user guides; they now include the information on an obscure text file on the iPhone that is unlikely to be seen by the user.

Until the separation distance allowance is removed from the testing procedure and cell phones are tested for compliance in the manner in which they are actually being used.....the FCC MUST require that manufacturers attach prominent, easy to understand stickers on all cell phones that are currently being designed and marketed to be used in the non-compliant manner of being tucked into breast or pants pockets, waistbands or bras. As an alternative to stickers, a short, easy to understand “flash” message (to never wear or use in a pocket or directly against the breast or torso) could be required to display upon power up on every phone.

234. SAR is a meaningless value for consumers to be made aware of the potential risks of exposure to microwave radiating devices. It is more useful to require handouts or visible information at the point of sale providing suggestions for ways to reduce exposure, especially for children and fetuses who are not taken into account by FCC exposure guidelines.

Manufacturers are not presently including separation distance information or SAR information as “suggested” by FCC guidelines – and if they are not legally required to do so, they most likely will not.

Point of sale information is only worthwhile if it is easy to understand and provided in a format that will likely be seen by the typical consumers (as opposed to deceptively “hidden” in the fine print of a poster on a wall that people just ignore). A simple handout is the most effective method of education; at the very least, consumers need to be provided the information on the FCC’s website about ways to reduce exposure if they are concerned.

The FCC openly admits they “sacrifice” public health to some extent, as they must also provide a vital communication network. Therefore, it is IMPERATIVE that consumers are ADEQUATELY informed at the point of sale about potential health risks of cell phone and other consumer devices so they can make informed decisions about ways to reduce exposure and about choosing accessories (cases, headsets, etc.)

235. Yes, it is helpful to have the FCC ID of a particular device readily available. It makes sense to include this information within an easily accessible file on the phone itself.

236. With respect to striking a balance between protecting the public and enabling the industry to provide communication services to US citizens, Consumers for Safe Cell Phones (CSCP) comments as follows:

The FCC is mandated to protect citizens from the known hazards of microwave

*radiation exposure. Nowhere is it stated that the FCC's function is to facilitate the telecom industry's profit-making potential. And, nowhere is it stated that FCC's function is to ensure citizens have unlimited access to **wireless** internet connection in their homes, public spaces, schools, public transportation to allow them to send photos, access email, connect on Facebook and download sports games and movies at all hours of the day and night. The LEGAL balance to be considered is between the risks to public health from microwave radiation exposure and ensuring a uniform, efficient, reliable communications network of services designed to ensure the safety and welfare of the American people. We implore the Commission to be clear about exactly what your role is in this balance as you weigh the costs and benefits to all the issues being considered herein.*

236. **It is not a fact that a 50-fold safety factor is adequate to protect public health from the known health risks of microwave radiation exposure.** It is NOT a guarantee that FCC's exposure limits are below the level "where known adverse health effects may begin to occur." Those statements are based upon obsolete scientific assumptions that since laboratory animals were affected at a whole body SAR of 4 W/kg, this is the "threshold" to use for humans. It was simply a "guess" that reducing that threshold by 50 would make for a good limit. It is based upon the outdated assumption that it is impossible for non-ionizing radiation to have any biological effect other than heating of tissue.

It is time for the FCC to drop this absurd reliance upon an obsolete assumption and take seriously the possibility that the current standard may be hundreds or thousands of times more lenient than what is necessary to adequately protect citizens from microwave radiation, especially given that we are all being exposed at greater intensity and for longer duration throughout the day and night – and given that children today will face a lifetime of exposure and the long-term effects are essentially unknown.

237. The statement that "the environmental exposure levels from fixed transmitters....are normally not only far below the MPE limit, but also well below exposure from a portable device such as a cell phone" exposes the GLARING problem with FCC's reliance upon IEEE and ICNIRP. **These are two organizations that are commonly known to represent the interests of the military and telecom industry. They do NOT represent the interests of public health. Those two organization's fundamental opinion that the only health impact of microwave exposure is of thermal effects renders the very basis of FCC's current standard erroneous and irrelevant.**

238. Until the FCC's acceptance of non-thermal biological effects, all of this consideration is a waste of time and taxpayer \$\$, not to mention the potential enormous health care costs our country may incur in the near future.

239. **Yes, the FCC must consider the probability of non-thermal effects and**

take precautionary action IMMEDIATELY.

242. The World Health Organization has declared this exposure as an IARC 2B carcinogen, placing it in the same health risk category as DDT and lead. This was based upon convincing scientific studies showing increases in rates of brain cancer (glioma) and other tumors after 10 years of use at an average of only 30 minutes a day AT THE CURRENT EXPOSURE STANDARD.

This alone is justification to re-evaluate the standards.

Additionally, the July 2012 GAO report, "Exposure & Testing Requirements for Mobile Phones Should Be Reassessed" directs the FCC to do just that....reassess the exposure and testing requirements.

244. The currently allowed separation distance for compliance testing of cell phones must be eliminated immediately as it does not test these consumer devices in the manner in which they are used. The July 2012 GAO report, 'Exposure & Testing Requirements for Mobile Phones Should Be Reassessed' pointed this out in their statement that the FCC ***"has also not re-assessed its testing requirements to ensure that they identify the maximum RF energy exposure a user could experience. Some consumers may use mobile phones against the body which FCC does not currently test, and could result in RF energy exposure higher than the FCC limit."***

245. As the FCC comments here, "The SAM does not model children....."

This alone is justification to re-evaluate the exposure standards.

247. YES! **There MUST be mandatory, enforceable requirements to ensure compliance with RF safety rules.** The FCC is a federal agency mandated to regulate public exposure to microwave radiation. How can the agency do the job it is required to do without mandatory, enforceable requirements?! We urge the FCC to include all mandatory requirements in the rules so there is no ambiguity about regulatory requirements. This must include specifics about policies for informing consumers of instructions to avoid over-exposure to RF as mandated in **CFR 47 15.21 Information to user.**

248. Encouraging manufacturers to "include information in device manuals to make consumers aware of the need to maintain the body-worn distance – by using appropriate accessories if they want to ensure that their actual exposure does not exceed the SAR measurement obtained during testing" has been a failed policy. **Manufacturers have NOT made consumers aware of this vital safe-use information.** The "body-worn" information that has been "encouraged" to be included in manuals has been deceptively hidden in the fine print in obscure locations that few ever see. No, consumers have not been made aware of the need to maintain the "body-worn" distance.

CSCP maintains that the term “body-worn” is inaccurate and misleading. In today’s market, “body-worn” implies use directly against the body as in a pocket or tucked into a bra or waistband. We urge the FCC to discontinue use of this term immediately and use more appropriate language that accurately reflects the situation, such as “used with distance between phone and body.” It is common knowledge that very few consumers use a holster or case that provides the separation distance required for compliance; and to our knowledge, no manufacturer provides these devices for their customers.

Again, we urge the FCC to discontinue the obsolete testing allowance of a separation distance as it is no longer appropriate given today’s norm of carrying and using phones with no separation distance.

249. Correction: to our knowledge, “body worn accessories such as holsters” are **NOT** supplied with a cell phone as assumed in this section. Also, users are not being informed to use a holster to maintain the required separation distance when worn on the body.

Consumers are not being adequately informed of the potential for overexposure due to “simultaneous transmission of multiple transmitters” while innocently making a call in a breast or pants pocket tightly pressed against the body. Rules **MUST** be promulgated as soon as possible to require that manufacturers/providers properly inform consumers of these over-exposure situations, especially with respect to children and the fetuses of pregnant women.

250. We emphatically state that it is unacceptable to simply suggest that manufacturers “should include operating instructions and advisory statements so that users are aware of the body-worn operating requirements for RF exposure compliance.” This “suggestion” is being blatantly disregarded by the industry the FCC is mandated to regulate and nothing has been done to rectify the situation. **If users are supposed to be made aware of these safe-use requirements as a condition for RF exposure compliance, then every cell phone being marketed today is a non-compliant device.** Until the obsolete allowance for a separation distance during testing on the body is deleted from the procedures, the FCC must establish a specific rule to **REQUIRE** the disclosure of this information. Hiding it in the legal fine print of user manuals or on files somewhere is **NOT** an acceptable form of disclosure and this consumer deception must no longer be allowed to continue.

Again, we stress the need to discontinue use of the phrase “body-worn” in the context of providing a separation distance. This is misleading as today’s user commonly associates the term “body-worn” with carrying and using a cell phone as they are designed and marketed to be used – in the pocket or tucked into a bra or waistband radiating directly into the soft tissues of the torso.

251. The “body-worn” testing for equipment authorization must be performed

without a spacer in order to properly simulate today's "normal operating position" of a cell phone. The FCC must either discontinue this obsolete practice that violates its Congressional mandate to protect citizens from the known hazards of microwave radiation....OR immediately issue a public statement that cell phones must never be used ½ to 1 inch from the body (as stated in terms the public will understand). It is not enough to refer users to their operating instructions, as they will NOT read the fine print, and some manufacturers such as Apple, no longer include this information in the manual.

In response to FCC's comment, "we have no evidence that this poses any significant health risk" - we respond that **the FCC has no evidence that placing a transmitter directly against the tissues of the breast and torso is safe!** Nor, does the FCC have information that positioning a transmitting cell phone during a 1 hour phone call directly into the abdomen (commonly used on the lap) of a pregnant woman is safe.

Regarding the erroneous and misleading statement, "using a device against the body without a spacer will generally result in actual SAR below the maximum SAR tested" - In the study, "SARs for pocket-mounted mobile telephones at 835 and 1900 MHz" (Kang, Gandhi, 2002 Phys. Med Biol. 47) it was found that the peak SAR's of a cell phone used in a pocket can be as much as 7 times greater than values obtained during compliance testing. It is wrong for FCC staff to justify their inaction due to an absence of scientific studies proving that using a cell phone directly against the breast tissues, male reproductive organs or abdomen of a pregnant woman is safe!

Regarding the misleading statement, "....moreover, a use that possibly results in non-compliance with the SAR limit should not be viewed with significantly greater concern than compliant use." This comment reads more like industry propaganda designed to assure consumers that there is no unsafe way to use a cell phone. The FCC must refrain from making these sorts of misleading, "industry-friendly" statements that have no scientific basis and **focus on protecting the American people from manufacturers' products that are being designed, marketed and used in ways that are in violation of FCC standards.**

The FCC is mandated to require manufacturers to test their products in the manner in which they are used by consumers. This is NOT happening. Manufacturers are allowed to improperly test and market consumer products that are designed to be used in a non-compliant manner, and the FCC is doing NOTHING to protect the American people from this possibly illegal activity.

The GAO report from July, 2012 admonished the FCC to discontinue this obsolete testing practice that allows consumers to be exposed to microwave radiation that may exceed the exposure limit; it has been over 1 year and this practice continues. This is an outrageous violation of the trust the American people have put into the FCC as our federal regulatory agency that is supposed to protect us from overexposure to this IARC 2B carcinogen. Your agency works for the American

people....not for the cell phone industry! This process of seeking comment on the issue of the separation distance at testing is a charade. Of course, industry representatives will comment that this places an undue burden on their profit-making potential. This is NOT an issue that needs input, as the directive to the FCC is clear.

While the FCC is providing these “stalling tactics”, millions of consumers are being exposed to levels of RF energy that exceed the limit. That is a fact **and action needs to be taken NOW.**

In response to the comment that the limits were set with a large safety factor that ensures the limit is “well below the threshold for unacceptable rises in tissue temperature”:

It must be noted that this opinion by FCC staff is based upon a rigidly held (likely erroneous) belief that there are no biological effects at non-thermal levels. It is troubling that the FCC holds onto this opinion with such certainty, even in the face of mounting scientific evidence of DNA damage and negative neurological and cardiovascular health effects at levels hundreds and thousands of times lower than the current limit.

Fourteen years ago, the FCC accepted that biological effects were shown to occur at non-thermal levels as referenced in this early version of OET Bulletin 56:

OET BULLETIN 56
Fourth Edition
August 1999

Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields

WHAT BIOLOGICAL EFFECTS CAN BE CAUSED BY RF ENERGY?

“More recently, other scientific laboratories in North America, Europe and elsewhere have reported certain biological effects after exposure of animals ("in vivo") and animal tissue ("in vitro") to relatively low levels of RF radiation. These reported effects have included certain changes in the immune system, neurological effects, behavioral effects, evidence for a link between microwave exposure and the action of certain drugs and compounds, a "calcium efflux" effect in brain tissue (exposed under very specific conditions), and effects on DNA.” (pg 8)

And, now, 14 years later, the FCC is “pretending” that non-thermal effects do not exist.

CSCP urges the FCC to discontinue making false, misleading statements that give assurances to American citizens that having a 50-fold safety factor

protects them from any harm due to exposure to microwave emissions from consumer products as well as towers, antennae, etc.

252. The FCC is mandated to adopt policies that require testing “body-worn configuration” as a cell phone is normally used. And, that is with no separation distance – “zero” spacing – actual contact with the body.

As mentioned previously, requiring advisory information must not be an option. Until the testing separation distance allowance is removed, all cell phone products must REQUIRE that users be informed. This clearly implies a prominent label on the product itself as consumers have been conditioned to ignore statements in legal fine print of manuals. A “flash” statement that appears on every cell phone upon power up is another option that might be considered. The separation distance message must be clear and user friendly in non-metric terminology and the font must be large enough to be seen by the typical user.

There really is no viable alternative other than to require compliance testing of cell phones (and laptops, tablets, etc.) in the manner in which they are being used.....with no separation distance. If manufacturers’ products are not able to pass the compliance safety testing guidelines without separation distance from the “body”they should re-design these products to ensure they can not be used by consumers in an unsafe manner.

Consumers for Safe Cell Phone Comments (Reply to
CTIA Comments from Sep. 13, 2013), Nov. 18, 2013

FCC 13-39

**Before the
Federal Communications
Commission Washington, D.C.
20554**

In the Matter of)	
)	
Proposed Changes in the Commission's Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure Limits and)	
Policies)	
)	

To: Office of the Secretary
Federal Communications Commission

In response to comments submitted 9/3/13 by CTIA – The Wireless Association

Comments Submitted By:

Consumers for Safe Cell Phones
Cynthia Franklin, President
520 Ridgeway Drive
Bellingham, WA 98225

Consumers for Safe Cell Phones is a 501C3 non-profit organization. I, Cynthia Franklin, attest that the following statements are true to the best of my knowledge.

JA 07630

Consumers for Safe Cell Phones submits the following comments in response to the September 3, 2013 submission by CTIA – The Wireless Association:

I. The supposed 50-fold safety factor does not protect the public from the known health risks associated with non-thermal effects from microwave radiation exposure

On page 12, the CTIA refers to comments made by the FCC in this NOI that imply that the incorporation of a fifty-fold safety factor “protects the public based on scientific consensus and allows for efficient and practical implementation of wireless services.”

The entire premise upon which this 50-fold safety factor claim is made is an untested hypothesis. There is no scientific evidence that backing down to 1/50th the SAR found to negatively impact the behavior of laboratory animals has anything to do with protecting humans from the known biological effects from exposure to microwave radiation. It is as if making assertions that the current FCC exposure standard, due to being 1/50th less than the SAR observed to cause serious biological effects in rats – and making these assertions over and over – will somehow magically render them true.

Again, there is no proof that a 50-fold safety factor ensures protection to citizens from the known health effects of microwave exposure.

Very concerning is the fact that there have been hundreds of peer-reviewed, independently-funded studies showing negative biological effects at levels as much as 1,000 times below the current FCC exposure standard!

The FCC is wrong to continue to propagate the unproven hypothesis that the current standards are protective of public health due to incorporating a 50-fold safety factor; this is factually a baseless assertion that has nothing to do with protecting public health.

The CTIA states on page 12 that public health organizations’, notable scientists’ and biologists’ claims of the existence of non-thermal effects are “controversial and unsubstantiated.” Additionally, the CTIA claims that the FCC has determined “that the scientific literature does not support the existence of such ‘non-thermal’ effects.”

This is false. Since 1999, the FCC has publicly acknowledged the existence of non-thermal effects from “relatively low levels of RF radiation”.

OET’s Bulletin 56 “Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields” (below) mentions knowledge of many scientific laboratories reporting effects from non-thermal levels of exposure including changes in the immune system, neurological effects, behavioral effects, evidence for a link between microwave exposure and the action of certain drugs and compounds, a “calcium efflux” effect in brain tissue....and effects on DNA:

OET BULLETIN 56

Fourth Edition

August 1999

Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields

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“More recently, other scientific laboratories in North America, Europe and elsewhere have reported certain biological effects after exposure of animals ("in vivo") and animal tissue ("in vitro") to relatively low levels of RF radiation. These reported effects have included certain changes in the immune system, neurological effects, behavioral effects, evidence for a link between microwave exposure and the action of certain drugs and compounds, a "calcium efflux" effect in brain tissue (exposed under very specific conditions), and effects on DNA.” (pg 8)

The FCC has been aware since 1999 that its exposure standard (by only considering the heating of tissue) is grossly inadequate in protecting public health. And, the FCC is aware that these reported effects occur at levels as much as 1,000 times below their current exposure standard.

Unfounded statements that a 50-fold safety factor protects the public from the known hazards of extremely low microwave exposure are scientifically baseless and wrong, and the FCC must stop propagating this known false and misleading statement.

The FCC is mandated to protect the public from these known non-thermal effects, and this is not happening. The FCC must take action immediately to promulgate rules to reassess the exposure guidelines based upon the known fact that extremely low levels of RF, levels as much as 1,000 times below the current standard, have been shown in hundreds of studies to cause troubling biological effects.

II. Body-worn usage is a safety issue and consumers must be informed to not wear or use cell phones directly against their bodies

On page 17, CTIA claims that there is no evidence that body-worn usage is a safety issue. This is not true. A recent study shows a direct correlation between the location of cancerous breast tumors and the wearing and using of a cell phone directly against the breast inside a bra (below):

Case Reports in Medicine

Volume 2013 (2013), Article ID 354682, 5 pages

<http://dx.doi.org/10.1155/2013/354682>

Accepted 19 August 2013

Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones

John G. West, Nimmi S. Kapoor, Shu-Yuan Liao, June W. Chen, Lisa Bailey, and Robert A. Nagourney

Abstract

Breast cancer occurring in women under the age of 40 is uncommon in the absence of family history or genetic predisposition, and prompts the exploration of other possible exposures or environmental risks. We report a case series of four young women—ages from 21 to 39—with multifocal invasive breast cancer that raises the concern of a possible association with nonionizing radiation of electromagnetic field exposures from cellular phones. ***All patients regularly carried their smartphones directly against their breasts in their brassieres for up to 10 hours a day, for several years, and developed tumors in areas of their breasts immediately underlying the phones.*** All patients had no family history of breast cancer, tested negative for BRCA1 and BRCA2, and had no other known breast cancer risks. Their breast imaging is reviewed, showing clustering of multiple tumor foci in the breast directly under the area of phone contact. Pathology of all four cases shows striking similarity; all tumors are hormone-positive, low-intermediate grade, having an extensive intraductal component, and all tumors have near identical morphology. These cases raise awareness to the lack of safety data of prolonged direct contact with cellular phones.

These young women did not have the opportunity to prevent this deadly disease as they had no way of knowing that it is potentially unsafe (i.e.; not compliant with safety standard) to wear or use their cell phones directly against their bodies. The separation distance warning that is required to appear in all user manuals as a condition of compliance with FCC testing guidelines is deceptively hidden in the fine print, in the technical/legal section typically at the backs of user manuals where consumers will be unlikely to read them.

III. Zero-spacing during compliance testing would simulate “real world” usage conditions

The CTIA on page 17 states that the FCC “evaluation criteria....should continue to be viewed as addressing all reasonable usage scenarios. CTIA....does not believe a zero-spacing measurement requirement would accurately mimic real usage or increase safety.”

A zero-spacing testing requirement does indeed mimic real usage as consumers typically wear and use cell phones tucked in shirt pockets (with essentially zero separation from the radiating structures of the antennae). Phones are being tucked into waistbands and bras with the backs of phones against the skin (with zero separation) for 10 or more hours a day with potentially many hours of transmission time throughout the day – and receiving calls and texts - while the phone is connected to a Bluetooth or wired headset.

The disclosure to never wear or use a phone closer than the separation distance allowed at testing is a crucial consumer safety warning. As the GAO confirmed in their July 2012 report, because the FCC allows manufacturers to test phones held up to 1 inch away from the measuring device during compliance testing, consumers who simply use their phones as designed (in pockets) are at risk of being exposed to microwave emissions that can exceed the current FCC standard.

The FCC must require testing of cell phones in the manner they are typically used – directly against the body with zero separation. This is of utmost importance given the fact that the industry is NOT taking action to adequately inform consumers of this potentially unsafe (i.e. non-compliant) usage situation.

On page 18, the CTIA asserts, “A very heavy burden indeed should be upon those who seek to alter the Commission’s approach to these issues with controversial science, changes to the testing standard, or opinionated and alarmist messaging premised on familiar but still unsubstantiated theories of harm.”

In reality, the assumption that the current FCC standards are protective of human health is the most controversial, unsubstantiated theory of them all! And, yet, the industry publicizes this message over and over, with media, and even high level FCC officers parroting the message until it has been widely accepted. No one wants to believe otherwise; consumers love, and have become dependent upon, their wireless devices and the benefits to society are recognized by many of us health and consumer advocates. But, wide dissemination and acceptance of propaganda does not make it true.

Wireless consumer devices emit an IARC classified 2B carcinogen. It is obvious that the burden of proof should be upon the industry manufacturing and marketing these potentially harmful products to prove that they are safe.

IV. Industry-funded Interphone study showed increased risk of glioma after 10 years of use at an average of 30 minutes a day

On page 21, the CTIA claims that the 2010 Interphone study “found no overall increased risk of glioma, meningioma or acoustic neuroma with mobile phone use of more than 10 years.” In this instance, the CTIA is attempting to re-write history. Of course, they are aware that the conclusion stated, “There were suggestions of an increased risk of glioma at the highest exposure levels.” And, the CTIA is very much aware that these “highest exposure levels” were defined as 10 years for an average exposure of 30 minutes a day. Hardly considered “heavy user” by today’s standards!

V. Currently, there is no scientific basis on which to rule out any possibility of a health risk

On page 25, the CTIA admits that there is “no scientific basis on which to absolutely rule out any possibility of [a risk to human health].” By failing to take precautionary action in the face of widespread use of potentially unsafe consumer products, the risk is that our country could be facing a public health crisis that would place an enormous economic and logistical burden upon our health care system, not to mention the unimaginable societal costs. Therefore, the FCC MUST rule on the side of caution as the stakes are too high to continue to take no action in the face of potential harm.

VI. The FDA states that additional research is warranted to address potential health risks to children

Pages 36 and 37 discuss the FDA’s website on “Radiation-Emitting Products.” The CTIA’s “cherry-picking” of FDA’s statements -attempting to show there is no proof of harm- failed to include the comment under “Current Research Results” that says, “...***still, there is consensus that additional research is warranted to address gaps in knowledge such as the effects of cell phone use over the long term and on pediatric populations.***” Clearly, the FDA’s position is that there does not exist enough research on children to rule out health risks from wireless usage. It is reckless and misleading for the CTIA, by omission, to imply that the FDA has no concerns about health risks from wireless use, especially as it relates to children.

VII. Scientific evidence exists to show that using a phone with zero separation results in increased risk of negative health impacts

On page 56, the CTIA comments again that “no scientific evidence suggests that failing to maintain a specified separation poses a health risk.” In addition to the above-mentioned study showing a correlation between wearing a cell phone in a bra directly against breast tissue and the location of cancerous tumors, there also exist numerous

studies (presented in previous submissions in this proceeding) on damage to, and reduction of, sperm for men who use and carry cell phones in their pants pocket. It is wrong to state that there is no scientific evidence suggesting that “failing to maintain a specified separation poses a health risk.”

Once again, CTIA uses the 50-fold safety factor as a reason that consumers should have no worries if they are exposed to SAR levels that exceed the current standard. However, as pointed out earlier in this submission, as well as by many other health advocates and experts – hundreds of peer-reviewed, independently-funded studies show DNA damage and other biological effects at as much as 1,000 times below the current standard.

There is NO research proving that exposure to microwave radiation 50 times below the current FCC standard ensures safety. And, there is no research proving that SAR is a valid method of testing as it only takes into account the rate of heating of tissue.

The burden of proof is on industry to prove that exposure levels that exceed the standard are safe. And, until that time, it is irresponsible for the CTIA to make unfounded claims that it is safe for consumers to be exposed to SAR levels that exceed the current standard.

VIII. CTIA’s former scientific expert says there is documented genetic damage at non-thermal exposure levels much lower than current FCC standards

It is important for the Commission to consider the words and expert opinion of a former CTIA scientist who was hired in the 1990s to head up CTIA’s program to study the potential negative health effects from cell phones. This industry insider was fired when he brought forth evidence to CTIA executives that the microwave emissions from cell phones did in fact cause genetic damage and other biological effects at non-thermal levels, much lower than those considered “safe” by the FCC.

From a March 2010 letter to the Maine legislature, Dr. George Carlo (who also has a law background) and who has since become an outspoken industry “whistle-blower” wrote:

*“...In both our federal and state legal systems, it is not the responsibility of consumers to prove that cell phones are dangerous in order to elicit protective measures from government and industry. **The product liability litigation and the regulatory systems underscore that the legal, moral and ethical burden of proof has been and continues to be on the cell phone industry to guarantee that their products that have been introduced into commerce are safe. To this point in time, the cell phone industry has failed to meet their burden of safety proof on any count. In fact, existing data show danger, not safety.***

· During the 1990s’, the program I headed which was funded by the mobile phone industry was intended to fill the safety study data gaps caused by the FDA’s error of

omission in 1984. Our work was specifically designed to meet all FDA standards for safety studies, including Good Laboratory Practices and other assurances of scientific rigor. As such, that work remains the only legitimate safety data on cell phones upon which a direct safety assessment can be made. Among the more than fifty studies completed in our program, were results indicating: genetic damage in human blood exposed to cell phone radiation; more than a doubling in the risk of rare neuro-epithelial brain tumors among cell phone users compared to non-users; and a statistically significant correlation between the side of the head where cell phones are used and the location of tumors among cell phone users. Any one of these findings, had they been completed in the context of mandated pre-market testing prior to 1984, would have prevented cell phones from making it into the market place. At the conclusion of the program in 1999, we recommended to both the cell phone industry and the FDA that a safety warning.... be issued to cell phone users. No government or industry protective steps were taken.

· The FDA has continued to fail in its duty to protect consumers from cell phone dangers. Historically and presently, the FDA refuses to demand both that cell phones undergo safety testing prior to marketing and that the industry look for health problems post-market among cell phone users. Post-market health data collection is standard practice for manufacturers of all other radiation emitting devices. It appears that the FDA is not seeking these data because it lacks the political will to recall or ban cell phones that pose dangers. At any point, the FDA can exert its authority and require that protective steps be taken. However, if the FDA's history on cigarette regulation is any gauge – the time lag between the Surgeon General's warning on cigarette packs in the 1960s and the FDA's first real regulatory action taken in 2009 was more than fifty years – consumers will be left unprotected and on their own for many years to come...

· The FDA has de facto abdicated its consumer safety responsibility regarding cell phones to the FCC, an agency with no statutory safety authority. While the FCC has the duty to ensure fair and balanced use of the airwaves, the Congress has never seen fit to empower the FCC with safety duties. Even under its far-reaching 1996 revisions to the Telecommunications Act, the Congress limited the FCC authority to publishing emission guidelines that companies must meet in order to obtain a license to sell specific phones. That testing for Specific Absorption Rate (SAR) is done by the industry itself with results submitted to the FCC on a voluntary and selective basis. The FCC does no post-market field-testing to ensure that those emission guidelines are met after phones are put into commerce. The 'honor system' is in place with the 'fox guarding the henhouse' for all practical purposes. Most importantly, however, is that the FCC's emission guidelines are not predictive of consumer safety. Promulgated in 1996 for digital phones and in 1997 for all other wireless devices, the emission guidelines are based on thermal data (harkening back to the microwave oven studies of the 1980s) and have been widely dismissed by the public health community as having no relevance to the pathological mechanisms through which cell phones do their damage."

IX. The cell phone industry is blatantly disregarding FCC's mandate that consumers must be informed of the separation distance necessary for compliant use

On page 56, the CTIA comments, "CTIA considers Supplement C's body-worn device separation requirement an issue of proper use and operation, as opposed to one of health and safety." And, they go on and try to make the case that the mandate that consumers are made aware of the required separation distance necessary to comply with simple operation procedures is not necessary. On page 57, the CTIA makes another unfounded and outrageous claim, "...because such disclosures are discretionary..." This is wishful thinking on their part as the rules are very clear that these disclosures are not discretionary. And, if the current Commission staff have been convinced that these consumer disclosures are merely "suggestions" for industry – they need to take a look at their own rules:

FEDERAL COMMUNICATIONS COMMISSION FCC 96-326

Washington, D.C. 20554 In the Matter of "Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation"
ET Docket No. 93-62

REPORT AND ORDER Adopted: August 1, 1996;

69. For purposes of evaluating compliance with localized SAR guidelines, portable devices shall be tested or evaluated based on "standard" operating positions or conditions. **In situations where higher exposure levels may result from unusual or inappropriate use of the device, instructional material should be provided to the user to caution against such usage.**

Seventeen years ago, it was inconceivable that consumers would be wearing and using cell phones closer than 2.5 cm from their bodies. When rules were adopted in 1996, making calls with a cell phone radiating against breast tissues, or tucked into breast and pants pockets would have been considered an "unusual or inappropriate use of the device." Clearly, the mention of "higher exposure levels" is in direct reference to a potential health or safety risk. Therefore, the rule states that "instructional material should be provided to the user to caution against such usage." The word "should" can not be interpreted to mean that this disclosure is "discretionary" as it is obviously intended to be a requirement of manufacturers being granted authorization.

The wireless industry has pulled the wool over the eyes of OET staff for years, convincing them that this disclosure is merely a suggestion, when in fact, disclosure of the necessary separation distance for safe usage is clearly a regulatory mandate that has been blatantly disregarded by the wireless industry, with absolute impunity.

In addition to the above referenced rule, please refer to the following FCC document:

FCC - OET EAS Form 731 Grant of Equipment Authorization

“...*End-users must be informed of the body worn operating requirements for satisfying RF exposure compliance.*”

This OET document maintains the original intent of the rule that consumers must be informed of the necessary separation distance – and that disclosure of this information is mandated as a condition of compliance.

The FCC must uphold its regulatory duty to protect citizens from the known health risks of microwave exposure and stop colluding with industry to “pretend” that these disclosures are not mandatory. And, with growing evidence that the current standards are set as much as 1,000 times higher than the levels now thought to cause concerning health impacts – it is imperative that, at the very least, industry must be held accountable for PROPERLY informing consumers that wearing and using cell phones closer than the testing distance will expose them to microwave radiation that may exceed the standard.

And, in reference to CTIA’s ridiculous claim on page 59 that “body-worn disclosures may simply create unnecessary confusion on the part of the consumer.....” – consumers are not so easily confused and will understand the simple caution to not wear or use a cell phone in a pocket, or tucked into a bra. And, yes, this may call into question the safety of cell phones. But, the truth is that there IS question about their safety, and until industry can prove their products are safe to use as they are designed and marketed – to be used in pockets or tucked into bras – failing to disclose federally mandated safety instructions is not only unethical, but it is a violation of consumer protection law.

Beginning on page 56, the CTIA comments span 5 pages of arguments as to why the current, obsolete testing separation distance allowance “more accurately mimic(s) real-world conditions than a zero-spacing protocol.” This is preposterous. The obvious “real world conditions” ARE zero-spacing between radiating structure and the torso. Very few people use holsters any more; the typical way cell phones are being used and carried is in a shirt or pants pocket, or tucked into a bra or waistband. And, for young people with developing neurological and reproductive systems, the “real-world” condition of having a cell phone directly on their body for 10 hours a day is clearly NOT taken into consideration with today’s standard. Many people wear a cell phone in a bra or pocket all day and make and receive calls while connected to Bluetooth with the radiating structures directly against the tissues of the body. There are no studies that show that this “abnormal usage” is safe.

It is really quite simple for the FCC in the issue of whether the testing protocol should be changed to zero-spacing. There is no other option other than requiring that all cell phones be tested with zero spacing as this is how cell phones are being used today:

1. The FCC's own rule states that "portable devices shall be tested or evaluated based on 'standard' operating positions or conditions." (see below)
2. Zero spacing is the typical (i.e.; standard) usage for which these products are designed and marketed to consumers. No one sees the separation distance safety disclosures deceptively hidden in the fine print of user manuals; the FCC is not enforcing its mandate that "end users must be informed" so consumers will continue to use cell phones in ways that expose them to microwave radiation that may exceed the standard.

FEDERAL COMMUNICATIONS COMMISSION FCC 96-326

Washington, D.C. 20554 In the Matter of "Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation"

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The FCC has no other option but to change the obsolete cell phone compliance testing protocol to require zero separation in order to simulate today's "standard operating positions." And, until this is changed, the FCC should enforce the current mandate that cell phone manufacturers MUST inform consumers not to wear or use their cell phones with backs of the phones closer than the necessary separation distance or risk being exposed to microwave emissions that may exceed the safety standard.

X. FCC must require labels or "flash" warnings to adequately inform consumers to never wear or use cell phones in pockets or tucked into bras

The "fine print safety warnings" currently being hidden in user manuals are mandated to be made visible to consumers as a condition for compliance – but, industry is disregarding this directive and current FCC staff is doing nothing to enforce the rule.

Therefore, FCC must require that the disclosures appear on a sticker attached directly to the phone or in a "flash" message that appears on every cell phone upon powering up.

Organizations; Environmental Working
Group, Reply Comments, Nov. 17, 2013

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)	
)	
Reassessment of Federal Communications)	ET Docket No. 13-84
Commission Radiofrequency Exposure)	
Limits and Policies)	
)	
Proposed Changes in the Commission’s Rules)	ET Docket No. 03-137
Regarding Human Exposure to Radiofrequency)	
Electromagnetic Fields)	

REPLY COMMENTS OF ENVIRONMENTAL WORKING GROUP

Environmental Working Group (“EWG”) submits these reply comments in response to the Federal Communications Commission’s (“FCC”) First Report And Order, Further Notice of Proposed Rule Making, and Notice Of Inquiry (“NOI”) in the above-captioned dockets. In its initial comments, EWG urged the Federal Communications Commission to strengthen its cell phone radiation standards so that they will adequately protect both children and adults, reflect actual current use patterns and provide meaningful consumer disclosure without preempting states from requiring additional disclosure. EWG also urged the FCC to not weaken its existing

standards by altering its testing guidelines to adopt average radiation exposure testing over a larger volume of tissue.

Some commenters in these proceedings have made a number of false assertions surrounding the safety factor in current RF standards, the state of the science surrounding potential harm from cell phone radiation, the adequacy of current federal and international standards to protect children and adults, the trends in RF exposure among Americans, the consensus of the international community on the need for precautionary action, and the pitfalls of increasing consumer education and transparency measures, among other issues. EWG submits the following comments to clarify the record and urges the FCC to dismiss these mischaracterizations.

I. THE FCC SHOULD DISMISS ASSERTIONS THAT CURRENT FEDERAL AND INTERNATIONAL STANDARDS FOR CELL PHONE RADIATION ARE OVERLY PROTECTIVE. IN REALITY, THESE STANDARDS ARE NOT SUFFICIENTLY PROTECTIVE OF CHILDREN OR ADULTS.

A. The FCC's standard does not include a 50-fold safety factor for exposure to the head, the organ of greatest concern for cell phone radiation.

Several groups put forth in their comments to the FCC that the 50-fold safety factor used to set federal standards makes those standards conservative. What is important to note, however, is that there is only a 50-fold safety factor employed for whole body SAR standards of 0.08 W/kg. The maximum SAR standard for the head, in contrast, is 1.6W/kg, giving a “safety factor” of only 2.5, which could be considered negligible. For hands, wrists, and feet there is no safety factor. This is a critical point given that one of the key organs of greatest concern when it comes to potential impacts of cell phone radiation.

To make matters worse, an assessment done by EPA in 1984 concluded that biological effects occur at SAR levels of 1 W/kg, 4 times lower than the level chosen by IEEE (U.S. EPA 1984). Therefore the point of departure of 4W/kg used by IEEE and adopted by FCC is likely an overestimate. Based on EPA's proposed point of departure of 1W/kg, and the unusually small safety factor applied by FCC, the calculated maximum SAR values are much higher than what would be assumed to be health protective. At best, FCC standards give adults a slim margin of safety over emission levels that harm animals. For children, the margin is even smaller.

B. Current standards do not account for children's higher RF exposures and greater health risks.

As detailed extensively in EWG's original filing, research shows that children may be more vulnerable to RF-EMF, yet limits on specific absorption rates are the same for children and adults and do not account for children's higher exposures and greater health risks. The size and tissue properties of a child's head increase radiation absorption, and several scientific studies have shown that the head and brain of a child absorb significantly more radiation than those of an adult (de Salles 2006; Gandhi 1996; Kang 2002; Martinez-Burdalo 2004; Peyman 2009; Wang 2003; Wiart 2008).

When cell phones are used by children, the average RF energy deposition is 2 times higher in certain regions of the brain and up to ten times higher in the bone marrow of the skull, compared to energy deposition in adult brains (IARC 2010; Christ 2010).

Comments submitted by the Mobile Manufacturers Forum state the phantom model is conservative. But research studies have indicated that the phantom model based on an adult head may grossly underestimate the RF-EMF exposure on a 1 gram level with respect to children, an issue of increasing concern. In a study published by France Telecom in 2008, peripheral brain tissue showed a maximum SAR two times higher than measured in adults due to lower

thicknesses of the pinna, skin and skull (Wiat 2008). All these data, taken together, suggest that when a child uses a cell phone that complies with the FCC standards, he or she could easily absorb an amount of radiation over the maximum allowed radiation limits defined by the federal guidelines.

C. Only 10 percent of EPA risk assessments employ uncertainty factors as low as 50.

Even it were true that the FCC's standards employed a 50-fold safety factor for adults and children, it is important to note that in government risk-assessments of environmental toxicants, a 50-fold safety factor is actually quite *low*. The Environmental Protection Agency, for example, typically uses safety factors in the 100s or 1000s range, sometimes as much as even 10,000. An EWG review of the 457 risk assessments that EPA has completed for potentially toxic chemicals finds that only 46 of them, or 10% employ safety factors of 50 or below (U.S. EPA 2013).

D. Harmonization with international standards would weaken current FCC standards.

Harmonization with international standards may seem would weaken current FCC standards because it would increase the average mass used in calculating SAR, and likely miss "hot spots" of radiation. As the mass used in the SAR value is increased the variations in exposure are averaged resulting in a corresponding decrease in the SAR value (Beard 2006). In studies using a patch antenna at 1850 MHz the 1 gram SAR values was calculated to be over 50% higher than the 10 gram SAR value (de Salles 2006).

Comments submitted by the Mobile Manufacturers Forum suggest that a 10 gram averaging mass is equivalent to the weight of the eye, one of the most sensitive organs, which when heated can cause cataracts, and therefore a 10 gram mass is more biologically based. This argument, however, is entirely misguided and grossly underestimates the size scale of localized

biological changes that may lead to long-term health consequences. The formation of cataract occurs in the lens portion of the eye (a very small part of the total eye) and occurs through the denaturing of proteins that then aggregate together and cause clouding of the lens by modifying the lens refractive index (Horwitz 2003). With the weight of these lens proteins in the attogram range, changing the averaging mass used in the SAR standard to a more biologically based number should result in a large reduction of the mass used to calculate SAR not an increase.

With biological effects occurring on the protein and single molecule level it is a concern that localized “hot spots” could also impact brain tissue (Blackwell 2009). Moreover, research has shown that using the SAR 1g calculation can be a better predictor of peak temperature increases and the location of the heating compared to the 10g model (Bakker 2011). Changing the current 1 gram mass used in calculating the SAR to a larger 10 gram mass would significantly underestimate exposure and discount the effects of localized biological damage.

II. THE FCC SHOULD REJECT CLAIMS THAT THERE IS NO EVIDENCE POINTING TO POTENTIAL HARM FROM EXPOSURE TO CELL PHONE RADIATION. THERE ARE NOW NUMEROUS STUDIES SUGGESTING THAT RF EXPOSURE AT CURRENT EXPOSURE LEVELS COULD HAVE NEGATIVE HEALTH EFFECTS, RASING QUESTIONS ABOUT THE ADEQUACY OF CURRENT STANDARDS.

A. Numerous human and animal studies now point to potential health concerns.

Some commenters contend that there is no convincing evidence of harm from cell phone radiation, while there is actually a growing body of research that points toward the opposite conclusion. In human studies, cell phone radiation has been linked to effects on male reproduction such as effects on sperm count and motility (Agarwal 2008; Agarwal 2009; De Iuliis 2009; Davoudi 2002; Gutschi 2011; Falzone 2011; Fejes 2005; Kilgallon 2005; Wdowiak 2007). Other reports suggest exposure to RF-EMF could be linked to obesity and behavioral

problems (Divan 2008; Divan 2012; Li 2012). And the International Agency for Research on Cancer (IARC) has classified radiofrequency electromagnetic fields as “possibly carcinogenic to humans (Group 2B)” based on increased risk for brain glioma observed during the large epidemiological INTERPHONE study (IARC, 2013).

There is a plethora of animal data suggesting exposure to RF may be harmful. Among the reported health impacts are effects on the developing fetus, neurological effects, reproductive effects, increased blood brain barrier permeability, hyperactivity, and immune system effects (Aldad 2012, Gul 2009, Nittby 2008, Odaci 2008, Sonmez 2010; Szmigielski 2013). Laboratory studies on the effects of cell phone radiation on rats, rabbits and other animals have also demonstrated a variety of effects on reproductive health (Al-Damegh 2011; Kesari 2011a; Kesari 2011b; Kesari 2012; Mailankot 2009; Salama 2009; Yan 2007). Some of these findings have been reported in humans, as noted above.

The CTIA states in its comments to the FCC that the INTERPHONE study found no increased risk for glioma. This is inaccurate. A 2011 article published in The Lancet that summarizes the results of the INTERPHONE study states that for the highest exposure (>1640 hours of use) “the OR for glioma was 1.40 (95% CI 1.03–1.89). There was suggestion of an increased risk for ipsilateral exposure (on the same side of the head as the tumour) and for tumours in the temporal lobe, where RF exposure is highest.” Therefore in some cases increased risk was reported (Baan 2011). In fact there are a variety of studies that have shown an increased risk of developing two types of brain tumors (glioma and acoustic neuroma) on the ipsilateral side (the side of the brain on which the cell phone is primarily held) among people who used a cell phone for longer than 10 years (Benson 2013; Hardell 2006b; Hardell, 2009; Hardell 2013; Lahkola 2007; Levis 2011; Schuz 2006).

Three recent studies also reported increased risk of salivary gland (parotid) tumors among cell phone users. Parotid gland malignancies involve tumors occurring in the largest salivary gland (parotid gland) located above the jaw and in front of the ear. Some results suggest these cancers were also associated with the duration of cell phone use (Duan, 2011; Lonn 2006; Sadetzki 2008). For example, a Chinese retrospective study of 136 patients with epithelial parotid gland malignancy found that long term and heavy use of cell phones was positively correlated with these tumors (Duan 2011).

It is important to note that the latency time for developing brain cancer is typically between 10-15 years (ACS, 2012). As we point out in the original comments filed, current studies may not be reflective of future trends in disease, particularly in those who began using cell phones as children. It seems likely that studies conducted in future years may find more consistent and higher cancer risks (Ahlbom 2004; Ahlbom 2009; Inskip 2010; Krewski 2001; Krewski 2007; Kundi 2009; Kundi 2004). Accordingly, a 2011 meta-analysis on head tumor risk and cell phone use found a significant increase in risk of ipsilateral brain gliomas and acoustic neuromas in people who had used cell phones for at least 10 years (Levis 2011).

In summary, emerging scientific data demonstrates that RF-EMF emitted from cell phones has the potential to adversely affect the health of people. This makes the case for setting a health-protective SAR limit and providing more information to consumers who wish to make informed choices.

B. There are several potential biological mechanisms for harm from RF energy.

In light of the growing scientific evidence showing that RF-EMF can exert negative effects on animals and may be associated with health effects in people, the question shifts to the mechanism by which RF-EMF may cause harm. Several suggestions have been made. Research

shows that electromagnetic radiation may disrupt the blood brain barrier (Ding 2010; reviewed in Nittby 2008; Söderqvist 2009a; Söderqvist 2009b). A number of studies examined the potential for genotoxicity (harm to genetic material that can lead to mutations and cancer) of electromagnetic fields (BioInitiative 2007; Phillips 2009). While the evidence is not yet conclusive, a meta-analysis of research published between 1990-2011 reports a significant association between DNA damage and radiofrequency fields in half of the results reported for 6 different indicators of genotoxicity in human cell lines (Vijayalaxmi 2012).

Scientists have also reported that cell phone radiation increases reactive oxygen species (ROS) inside the cell (Güler 2012; Irmak 2002; Kesari 2011a; Kesari 2012; Lu 2012; Zmyslony 2004). In turn, higher ROS levels trigger intracellular signaling cascades that can interrupt the smooth functioning of the cell or lead to cell death. Cell phone radiation-induced ROS may well be a causative agent that induces DNA damage, which is a precursor to cancer (Phillips 2009) and a potential mechanism of toxicity to sperm cells (Agarwal 2009; De Iuliis 2009; reviewed in Desai 2009; Kesari 2012; reviewed in Kesari 2013).

C. If researchers are finding effects at current levels of exposure to cell phone radiation, this raises serious questions as to whether FCC and international standards are truly conservative.

Some commenters have asserted that the current FCC standards and international standards are very conservative, and therefore there should be no hesitation to harmonize the standards. However if the associations between male reproductive effects, cancer, and cell phone radiation are real, these effects are occurring at the exposure levels allowed in current standard. Recent studies on men exposed to cell phone radiation at current levels show an association between reduced sperm count and motility and phone use (Agarwal 2008; Agarwal 2009; De Iuliis 2009; Davoudi 2002; Gutschi 2011; Falzone 2011; Fejes 2005; Kilgallon 2005; Wdowiak

2007). It is also concerning that animal studies have shown adverse effects at exposure levels experienced by humans. For example, fetal exposure to 800-1900 Mhz-rated cell phones produced neurodevelopmental and behavior effects in mice (Aldad 2012).

III. THE FCC SHOULD DISMISS REQUESTS FOR THE TESTING REGIME TO REMAIN UNCHANGED. THE FCC MUST MODIFY ITS TESTING GUIDELINES TO INCLUDE “ZERO SPACING” TO ACCOUNT FOR THE SIMPLE FACT THAT MANY CONSUMERS CARRY THEIR PHONES DIRECTLY AGAINST THEIR BODIES.

A. Consumers sometimes carry cell phones directly against their bodies; the FCC’s standards must be updated to reflect this simple fact.

In its Notice of Inquiry, the FCC acknowledges that there are “circumstances where test configurations may not reflect actual use” because current federal guidelines allow cell phone companies to use a spacer of up to 2.5 centimeters in “body-worn testing configurations.” These guidelines appear to stem from an FCC assumption in 1996 that consumers would be carrying their phones in holsters, rather than directly against the body.

Whatever the reason for the agency’s earlier decision, it is clear that the FCC must now update its testing guidelines to reflect the reality that many people commonly carry their phones directly against the body, often putting them phones in a pocket or and placing them on the lap – sometimes even placing them in their bras. Several commenters have asserted that a zero-spacing requirement would not mimic real usage, but this is simply untrue.

Notably, a 2012 Government Accountability Office (GAO) report concluded that consumers who hold a phone directly against the body could receive “*RF energy exposure higher than the FCC limit*” and recommended that the FCC “[r]eassess whether mobile phone testing requirements result in the identification of maximum RF energy exposure in likely usage

configurations, particularly when mobile phones are held against the body, and update testing requirements as appropriate” (GAO 212).

EWG strongly agrees with this recommendation. Given that holsters and belt clips are not commonly used today, it makes no logical sense to test RF exposure compliance of wireless devices at *any* distance from the body if the agency aims to simulate real-world usage. This is particularly important since at least some testing has indicated that RF exposure from an iPhone 4 would exceed FCC guidelines by a factor of three if tested right next to the body (Pong 2012). The difference is between allowing a 2.5 cm gap and zero spacing is not trivial.

Some commenters have suggested that it would be difficult for phones currently on the market to comply with zero-spacing proximity requirements. This should not be a reason for the FCC to keep the current testing regime. Manufacturers are constantly innovating and will be able to design for changes in the proximity requirement.

B. The industry’s SAR Tick program will not solve the inherent problems with FCC testing regimen.

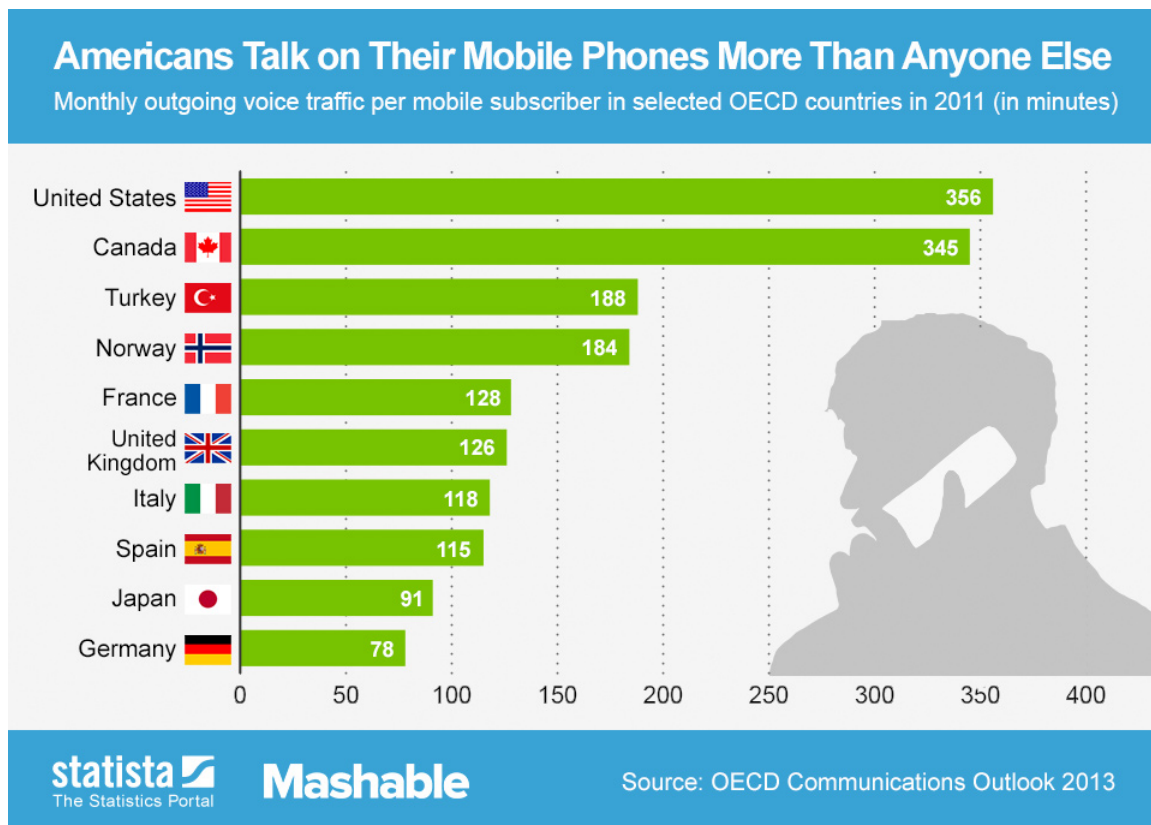
Some commenters have suggested that the cell phone industry’s new “SAR Tick” program will address the concerns around FCC’s flawed proximity testing because consumers will be better educated about how to properly use their phones so as not to exceed SAR limits. Yet the simple fact is that few consumers ever look at their cell phone manuals, and more importantly, consumers should be given real protection based on how they *actually* use their phones – not how the FCC falsely assumes people would use their phones (i.e. in a holster).

IV. AMERICAN’S EXPOSURE TO CELL PHONE RADIATION IS ON THE RISE, AND LIKELY TO INCREASE FURTHER WITH THE TRANSITION TO LTE NETWORKS.

A. The average number of minutes Americans spend talking on their cell phones has increased by 6.5 times since 1996; Americans talk on their cell phones more than people

in any other country.

According to data published in 2013 by the Organization for Economic Co-operation and Development (OECD), the number of minutes Americans have spent talking on their cell phones has increased from 651 minutes per year in 1996, to 1,929 minutes in 1999, to 3,369 minutes in 2004 to 4,273 minutes in 2013 (OECD 2013). In other words, the amount of time Americans have spent talking on their cell phones has increased by a factor of 6.5 since 1996. It is also worth noting that Americans spend more talking on their phones than in other countries as the graph below demonstrates (Statista 2013).



A. Recent studies suggest that average radiation exposure will increase with the transition to LTE networks.

Some commenters have correctly stated that there was a major reduction in consumer

radiation exposure in the shift from 2G to 3G WCDMA transmission technologies. While 2G transmitted at 20-70 percent maximum SAR in average usage, 3G phones generally transmitted at levels below 1 percent of maximum SAR (Gati 2009; Vrijheid 2009).

What was not mentioned, however, is that experts have raised concerns that LTE transmission technology and its multiple-in/multiple-out antenna designs have transmission characteristics similar to 2G technology and that exposure will be a larger fraction of maximum SAR than 3G technology (Shi 2012; Anderson 2011). One recent study, for example, has shown that, for a given power output to the antenna, the newer 4th generation LTE antenna design produces a SAR value that is 2-to-60 times greater than the 2G and 3G designs (Shi 2012).

V. THE NEW “SAR TICK” INITIATIVE AND OTHER EFFORTS BY THE FCC AND THE CELL PHONE INDUSTRY DOES NOT COME CLOSE TO PROVIDING SUFFICIENT REAL-WORLD INFORMATION FOR CONSUMERS ABOUT CELL PHONE RADIATION.

A. The FCC and industry acknowledges the inherent problems with using SAR as a proxy for exposure. Therefore, any education efforts that focus on SAR values will be insufficient to satisfy consumers’ right-to-know.

On its website the FCC describes in detail why the maximum Specific Absorption Rate (SAR) – currently the *only* RF exposure metric tested by the FCC and made available to consumers – is not a good predictor of actual exposure to RF energy from cell phones (FCC 2013). The FCC notes, for instance, that “a single SAR value does not provide sufficient information about the amount of RF exposure under typical usage conditions to reliably compare individual cell phone models” (FCC 2013). Therefore, doing a slightly better job at disclosing SAR values to consumers will accomplish little.

B. RF exposure varies by service provider, transmission technology, frequency bands, location and proximity to cell phone towers.

Recent studies have indicated that a consumer's choice of wireless network, with its associated frequency bands and transmission encoding, may be a more important factor in cell phone RF exposure than the cell phone model. The technology used in transmitting and encoding cell phone signals has been changing every few years: from GSM to CDMA to WCDMA and most recently to LTE. The changing antenna design, transmission frequency and encoding have large effects on average RF exposure levels (Shi 2012, Kelsh 2011).

As described above, for a given power output to the antenna, the newer 4th generation LTE antenna design produces a SAR value that is 2-to-60 times greater than the 2G and 3G designs (Shi 2012). Research has shown that there was a major reduction in consumer radiation exposure in the shift from 2G to 3G WCDMA transmission technologies. While 2G transmitted at 20-70 percent maximum SAR in average usage, 3G phones generally transmitted at levels below 1 percent of maximum SAR (Gati 2009; Vrijheid 2009). As the technology has evolved, concerns have been raised that LTE transmission technology with multiple-in/multiple-out antenna designs have transmission characteristics similar to 2G technology and that exposure will be a larger fraction of maximum SAR than 3G technology (Shi 2012; Anderson 2011).

Although studies have found marked differences in average SAR levels among cell phone networks, the FCC currently provides consumers with absolutely no information to assist them in choosing a cell phone provider that will expose them to lower cell phone RF energy. This not only inhibits consumer's ability to make informed purchasing decisions, it also deprives the public of its right to know. Because it is now clear that cell phone network technologies affect RF exposure as much as the phone design itself, the FCC-mandated exposure metrics should incorporate both parameters in an expected in-use SAR rating.

V. THE FCC SHOULD DISMISS ASSERTIONS THAT ENCOURAGING METHODS

FOR LIMITING RF EXPOSURE AND PROVIDING ADDITIONAL CONSUMER DISCLOSURE WILL CAUSE CONFUSION, ALARM, AND/OR DISCOURAGE THE USE OF PORTABLE DEVICES.

CTIA suggests that providing more information to consumers about cell phone radiation standards and ways to reduce exposure would create unnecessary fear, confusion, and discourage the use of mobile devices. This is absurd. Given their incredible usefulness, it is quite clear that consumers will continue to buy and use mobile devices. Consumers receive many types of warnings and advice on a vast array of consumer products that remain widely used nonetheless; there is nothing to suggest that cell phones would follow a different trend.

CTIA suggests that setting a conservative standard could “have the perverse effect of increasing public anxiety,” yet it is more likely that the setting of health protective RF standards will have the opposite effect and ease public anxiety. Consumers will view this as a positive response to a potential public health issue, and see that the FCC is taking the health of children into account. The public wants regulations that will protect them. If the government errs on the side of caution, the public will have the peace of mind to know that good faith efforts are being made to protect from potential adverse health effects. If the government errs of the side of less protection, this decreases trust in regulatory agencies and does not ease anxieties about potential harm.

VI. RECENT INTERNATIONAL ACTIONS SHOW GROWING CONCERN OVER POTENTIAL EFFECTS OF CELL PHONE RADIATION, PARTICULARLY FOR CHILDREN.

Several parties stated in their comments to the FCC that there is international consensus that cell phone radiation poses no health concerns and that the current standards are overly conservative. Recent action taken by countries around the world, however, demonstrate that this

assertion is false. In reality, there are a growing number of countries who are taking precautionary action as well as increasing consumer access to information.

France

In 2010, The French government banned cell phones directed at children under 6, cell phone advertising to youth under 14, and restricted use of mobile phones in school by children during lesson times (Article L511-5, Code of Education). All phones sold in France must come with a headset, and SAR values must be displayed at the point of purchase whether in stores or online. The French government, through its National Institute for Prevention and Health Education operates a cell phone safety educational program (France NIPHE 2013).

Belgium

In October of 2013, Belgium adopted new cell phone regulations that bar mobile phone models designed for, and marketed to children ages 7 and younger. Under Belgium's new rules, slated to take effect next March, cell phone retailers will be also required to disclose phones' SAR values at the point of sale (Belgium FPS 2013).

India

In 2012, the Indian Department of Telecommunications ruled that all new cell phone models manufactured in or imported into India shall "comply with the SAR values of 1.6 W/kg averaged over 1 gram of human tissue," as of September 1, 2013 and existing models that are compliant with the European standards of 2.0 W/kg averaged over 10 gram of human tissue are only be manufactured in or imported into India until August 31, 2013 (India DOT 2012). The Indian government also requires that SAR values be displayed at the point of sale.

European Union

Member states of the Council of Europe adopted a resolution in 2011 recommending among other things, to “take all reasonable measures to reduce exposure to electromagnetic fields, especially to radio frequencies from mobile phones, and particularly the exposure to children and young people who seem to be most at risk from head tumours” (Council of Europe 2011).

In 2008, the European Parliament approved a resolution calling for stricter exposure limits for cell phones and other wireless devices. “[The Parliament notes] that the limits on exposure to electromagnetic fields which have been set for the general public are obsolete. They do not take account of developments in information and communication technologies or vulnerable groups, such as pregnant women, newborn babies and children. The plenary therefore calls on the Council... to take into account the Member States' best practices and thus to set stricter exposure limits for all equipment which emits electromagnetic waves in the frequencies between 0.1 MHz and 300 GHz” (European Parliament 2008b). Article 22 of the 2008 Resolution highlights the importance of the precautionary approach supported by the European Environment Agency and promotes adoption of the stricter emission standards such as those developed in Belgium, Italy and Austria (European Parliament 2008a).

The European Parliament resolution on “Health concerns associated with electromagnetic fields” (INI/2008/2211), adopted by 559 votes to 22 on 2 April 2009, called for bringing greater transparency to the radiofrequency radiation exposure and for adoption of precautionary measures. The resolution stated: “Wireless technology (cell phones, Wi-Fi/WiMAX, Bluetooth, DECT landline telephones) emits EMFs that may have adverse effects on human health. Most European citizens, especially young people aged from 10 to 20, use a cell phone, while there are

continuing uncertainties about the possible health risks, particularly to young people whose brains are still developing” (European Parliament 2009). The resolution also called for a “wide-ranging awareness campaign should be initiated to familiarize young Europeans with good cell phone techniques, such as the use of hands-free kits, keeping calls short, switching off phones when not in use (such as when in classes) and using phones in areas that have good reception.”

Switzerland

The Swiss Federal Office of Public Health states on its website that although the one study looking at mobile phone use and brain tumors in children did not find a link, there is “uncertainty over the extent to which children's heads absorb radiation and about the effect on the development of nerve tissue and the brain. These uncertainties and the fact that mobile phone usage is beginning at an increasingly young age justify the use of low-emission mobile phones, especially in children and adolescents” (Swiss FOPH 2013). Similar findings are made for impacts of cell phone radiation on sperm, stating that: “As a precaution, mobile phones should not be positioned close to the genitals when making calls with hands-free devices.” In general, the Office advises consumers to minimize their exposure by using a hand-free system, keeping calls short, buying phones with low SAR values and using phones when the signal quality is good.

Germany

The German Federal Office for Radiation Protection (Bundesamt für Strahlenschutz, BfS) has created a “Blue Angel” eco-seal for low-emission cell phones, which are defined as those phones have emissions at or below 0.6 W/kg (BfS 2013a). BfS recommends a precautionary approach to cell phone use, particularly for children, such as using a landline;

making shorter cell phone calls; avoiding using a cell phone when the connection is weak; and, as much as possible, using a headset and substituting text messaging instead of making a call (BfS 2013b).

Israel

In 2008, Israel's Ministry of Health stated that although it is still not clear whether cell-phone use is connected to an increased risk of developing cancerous growths, current research already supports a policy of "preventive caution" (Israel Ministry of Health 2008). The Ministry published a set of guidelines that called for limiting children's use of cell phones, avoiding cellular communication in enclosed places such as elevators and trains, and using wired, not wireless, earpieces (Azoulay 2008). The Ministry developed these guidelines following a national study that detected an association between cell phone use and the risk for developing tumors of the salivary gland (Sadetzki 2008; Traubmann 2007).

Canada

Canada's federal public health department, Health Canada, states on its website: "Health Canada reminds cell phone users that they can take practical measures to reduce their RF exposure by: limiting the length of cell phone calls, using "hands-free" devices, replacing cell phone calls with text messages." "Health Canada also encourages parents to take these measures to reduce their children's RF exposure from cell phones since children are typically more sensitive to a variety of environmental agents" (Health Canada 2013).

United Kingdom

The UK Department of Health supports "a precautionary approach" to the use of cell phones until more research findings become available. In 2000, the UK convened an expert panel

to examine the potential health effects of cell phone radiation, and the results were published in what became known as the “Stewart Report.” As described on Public Health England’s website:

“This expert group concluded that there was no clear scientific evidence of harm to health from exposure to mobile phone signals. However, the expert group was concerned about the widespread adoption of a new technology involving exposure from radio waves to people's heads, including those of children, at levels that are significant fractions of international guidelines. This, and some uncertainties in biological evidence, led the expert group to advise some precaution, particularly in the use of mobile phones by children. This advice was accepted by the Department of Health and leaflets and other information were provided for the public in 2000 and 2004. The basic advice from the Stewart Report continues to be the advice of the Health Protection Agency. The benefits of mobile telecommunications are widely recognised but, given the uncertainties in the science, some precaution is warranted particularly regarding the use of handsets held against the head. This is especially relevant to the use of handsets by children and the Agency recommends that excessive use by children should be discouraged” (Public Health England 2013).

Finland

In January 2009, the Finnish government stated that children's cell phone use should be restricted, for example, by sending text messages instead of talking, making shorter calls, using a hands-free device, and avoiding the use of cell phones when connection is weak. According to the Finnish report, “although research to date, has not demonstrated health effects from cell phone’s radiation, precaution is recommended for children as all of the effects are not known” (STUK (Finnish Radiation and Nuclear Safety Authority) 2009).

The Finnish Radiation and Nuclear Safety Authority's website states that children have a "special status as mobile phone users, among others, because brains continue to develop even up to 20 years of age. It should also be taken into account that children will have much more time to use mobile phones than adults today who started their regular mobile phone use only about ten years ago. The risk of long-term use of mobile phones cannot however be assessed with certainty until mobiles phones have been in use for several decades. On the grounds of the above-mentioned facts, STUK states that it is reasonable to restrict children's use of mobile phones..." (STUK (Finnish Radiation and Nuclear Safety Authority) 2013).

Russia

Listed in the Sanitary Rules of the Russian Ministry of Health (SanPiN 2.1.8/2.2.4.1190-03 point 6.9), are cautions against persons under 18 using mobile phones. The National Committee for Non-Ionizing Radiation Protection issued guidance in 2008 on the subject of children and mobile phones based on the concern and cite potential risk of illness from cell phone use to children under 16, pregnant women, epileptics, and people with memory loss, sleep disorders and neurological diseases (RNCNIRP 2008). Both the Russian Ministry of Health and the members of Committees of health protection in the Russian Parliament support the viewpoints of the RNCNIRP.

VII. TAKING PRECAUTIONARY MEASURES IS NOT UNSCIENTIFIC.

EWG strongly disagrees with CTIA's suggestion that "the fundamental nature of the "precautionary principle" means that those decisions are untethered from the existing body of scientific research." It is unnecessary and onerous to require absolute certainty before implementing standards and regulations intended to protect public health. If the scientific

evidence is sufficiently suggestive that there is a potential risk to public health, action should be taken to prevent that threat. This is the basis of the precautionary principle. Decisions under this paradigm are made with the recognition that there are always unknowns in science.

The precautionary principle is highly regarded and used by scientists and government agencies worldwide. In the European Union, the precautionary principle is accepted as an important aspect of environmental policy (Europa 2011). It is embedded in a number of environmental and public health policies in countries such as Denmark, Germany, United Kingdom and Sweden (Lokke and Christensen, 2008). Denmark, for example, utilized the precautionary principle to call for the prohibition of phthalates in children's toys (1997), to recommend avoiding triclosan in consumer goods (2001) and to recommend that specific sunscreen ingredients (4-MBC) should not be used on children under 12 years (2001) (Lokke and Christensen 2008).

The precautionary principle is also well utilized in the United States. The San Francisco Department of the Environment highlights the principle as “the first guiding principle [to reduce the impact of harmful chemicals on San Franciscans and [the] environment]” (San Francisco Department of the Environment 2013). The American Public Health Association, “recognizing that public health decision must often be made in the absence of scientific certainty, or in the absence of perfect information” explicitly endorses the precautionary principle “as a cornerstone of preventative and public health practice” (APHA 2000).

According to Kriebel (2001), one of the primary tenets of the precautionary principle is to take “preventative action in the face of uncertainty”. In this vein, health agencies in six nations – Switzerland, Germany, Israel, France, United Kingdom and Finland – have recommended reducing children's exposure to cell phone radiation in light of growing evidence of adverse

health impacts.

The CTIA also suggested that “further precautionary measures” would be arbitrary and capricious. However, there is new scientific evidence that children may be at an increased health risk, in addition to new data in animals and people suggesting what those health risks may be. Therefore further precautionary measures taken by FCC would neither be arbitrary or capricious. Not only are precautionary actions perfectly reasonable, in light of the new science they necessary to protect public health.

The precautionary principle is an important tool to help protect the public from environmental risks and remains a strong basis to call for the FCC to strengthen their cell phone radiation standards so that they will adequately protect both children and adults. Given the unknowns regarding the adverse effects of cell phone radiation and the widespread nature of exposure, the FCC is exercising remarkably little precaution in this matter.

VIII. CONCLUSION

Faced with an exploding cell phone market, growing evidence of potential harm from cell phone radiation and uncertainties that will likely remain unresolved for decades to come, it would be a mistake for the FCC to essentially weaken its standards by “harmonizing” them with international standards. Rather, this is the time to strengthen federal standards, make them more reflective of how consumers actually use their phones, provide consumers with useful, real-world information they can use to inform their choice of phones and networks, and educate consumers about other ways to reduce their exposures.

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